FEDERAL TECHNOLOGY TRANSFER POLICIES AND OUR FEDERAL LABORATORIES: METHODS FOR IMPROVING INCENTIVES FOR TECHNOLOGY TRANSFER AT FEDERAL LABORATORIES

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON TECHNOLOGY

AND THE

SUBCOMMITTEE ON BASIC RESEARCH

OF THE

COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FOURTH CONGRESS

FIRST SESSION

JUNE 27, 1995

[No. 13]

Printed for the use of the Committee on Science

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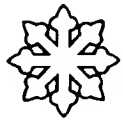

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(Vacancy)
(Vacancy)

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[1] Ranking Minority Member.
[2] Vice Chairman.

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APPENDIX I

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

FEDERAL TECHNOLOGY TRANSFER POLICIES AND OUR FEDERAL LABORATORIES: METHODS FOR IMPROVING INCENTIVES FOR TECHNOLOGY TRANSFER AT FEDERAL LABORATORIES

TUESDAY, JUNE 27, 1995

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE,
SUBCOMMITTEE ON TECHNOLOGY,
SUBCOMMITTEE ON BASIC RESEARCH,
Washington, DC.

The subcommittees met at 1:05 p.m. in Room 2318 of the Rayburn House Office Building, the Honorable Steven H. Schiff, chairman of the Subcommittee on Basic Research, presiding.

Mrs. MORELLA. I think I'll call the meeting to order now. I want to welcome you to today's joint hearing of the Technology Subcommittee and the Basic Research Subcommittee chaired by my good friend and colleague, the distinguished gentleman from New Mexico, Mr. Schiff, who will be with us momentarily.

Today's topic, a federal technology transfer and federal laboratories, is one of great interest to both of our subcommittees. I believe that this posture hearing should be helpful to the members of the subcommittees as we review pending legislation, and should be especially useful in providing important historical and practical background to the newer members regarding federal technology transfer policies and our federal laboratories.

Actually, in order to move more effectively, and to tap into the expertise of our witnesses, I have asked all the panelists to submit their opening statements for the record. With the convening of each panel, we're going to ask the members to proceed directly to the questioning of witnesses. I think a lot of information will come out that way.

This procedure should result in an effective dialogue with all of the panelists and the members.

The economic advances of the 21st century are rooted in the research and development performed in laboratories around the world today. Therefore, our future well-being as a nation becomes dependent upon the continuous transfer of basic science and technology from the laboratories into commercial goods and services.

Congress has long tried to encourage the transfer of technology and collaboration between our laboratories and industry. Beginning with the landmark 1980 Stevenson-Wydler Technology Innovation Act, we have enacted legislation explicitly instructing our nation's

federal laboratories to seek commercial opportunities for their technologies, and to make technology transfer a job responsibility of every federal scientist and engineer.

This is eminently logical, since federal laboratories are one of our nation's greatest assets. Yet, they are also a largely untapped resource of technical expertise. There are over 700 federal laboratories throughout the nation occupying one-fifth of the country's lab and equipment capabilities, and employing one of every six scientists in the United States.

Representing Montgomery County, Maryland, I'm fully aware of the high quality work and the vital role that federal laboratories play in our nation's research and development. I believe our nation's future economic well being is simply too important to exclude the resources and abilities of our nation's federal scientists.

One very successful method of effectively utilizing our federal laboratories has been through the use of cooperative research and development agreements called CRADAs. I've always been a strong supporter of CRADA development, and have attempted to resolve barriers and remove impediments in its creation.

In the past two Congresses, I have joined forces with Senator Rockefeller of West Virginia in this effort. And in this Congress, we are teaming up once again to introduce legislation which is very similar to the bill which we introduced last year.

We have created a slightly updated version of our bill and we are anticipating an introduction date after we return from the Independence Day District work period.

I'd like to take the opportunity in today's hearing to discuss this pending legislation, to get the advantage of your views on it. Copies of the draft text have already been provided to all the witnesses, and any comments that you might like to make, I would appreciate.

The testimony from today's hearing will be used to supplement the hearing record on the bill already established in the previous Congress.

The purpose of the upcoming bill is to provide assurances to United States industry that sufficient rights to intellectual property resulting from collaborative agreements with federal laboratories will be granted to justify prompt commercialization of resulting discoveries.

The bill would also provide important new incentives to federal laboratory personnel to partner with industry at a time that both need to work closer together for their mutual benefit.

In this way, a CRADA would be made more attractive to both American industry and federal laboratories. The bill would amend the Stevenson-Wydler Act by directing federal laboratories to provide title to intellectual property arising from joint research under a CRADA to the private sector collaborating parties.

In the situation of jointly developed technology arising under a CRADA, the collaborating party would have the right of first refusal to an exclusive license in that technology, allowing for the possibility to negotiate an exclusive license for a specific field of use.

The collaborating party would have the right to use the technology in exchange for reasonable compensation to the laboratory,

and upon submission of a satisfactory plan, to commercialize that invention.

In addition, the bill provides that the federal government will retain a paid-up license to use the technology for its own purposes. And if the title holder does not commercialize the technology in any field of use, or is not manufactured in the United States, it could grant a license to another company. These are the so-called march-in rights.

The bill would also seek to encourage greater cooperation between federal labs and U.S. industry by enhancing the financial incentives paid to federal laboratory scientists for technology that results in marketable products.

These incentives are paid from the income the laboratories received for commercialized technology, not from tax dollars.

We have a distinguished group of experts today, with a great deal of hands-on experience in technology transfer. And I am certainly eager to hear their testimony.

I want to thank you for indulging me in an extensive opening statement, particularly in explaining the bill, that I hope that you will comment on also. And I now yield time to the distinguished Chairman of the Basic Research Committee, who is here right now. So I will yield time to my distinguished ranking member on the Subcommittee on Technology, Mr. Tanner.

Mr. TANNER. Thank you, Chairwoman Morella. I appreciate very much this opportunity to have learned people in our country come and testify to these committees who are assembled here about the technology transfer program.

I would suggest that in light of some of the recent events, that this is as important a hearing as we will have, as it relates to the competitiveness of the United States of America in the future world.

We have, according to the Office of Management and Budget, we'll have more than 6,000 active cooperative research and development agreements with industry and universities in 1995 with more than $5 billion. So we're talking about programs where the people of this country have a sizeable investment in transferring technology developed in our national labs to our industries so that they may be competitive in a world economy.

I would suggest there may be no other hearing any more important than this one today. And for that reason, I thank you for having it.

I am particularly delighted as a Tennessean to see Mr. Martin and Ms. McKinley from Oak Ridge here. I appreciate all our panelists.

And with that I'll just wait until we have the time. Thank you.

[The prepared opening statement of Mr. Tanner follows:]

Opening Remarks
The Honorable John S. Tanner

Good Afternoon and I want to add my welcome to everyone here today. I want to commend Chairwoman Morella for holding this hearing to examine technology transfer programs at the Federal labs. I would also congratulate her for her work on drafting legislation to improve technology transfer at Federal laboratories.

Before we begin, I'd just like to throw out a few facts regarding technology transfer programs at Federal labs. According to the Office of Management and Budget, the Federal Government will have more than 6,000 active Cooperative Research and Development Agreements with industry and universities in 1995. These agreements are worth more than $5 billion. In addition, the Small Business Innovation Research Program will provide almost $1 billion to small and medium sized companies through out the country. So we're talking about programs in which the Federal government has made a sizeable investment.

Recently, we've heard a lot of debate about the merits of Federal technology transfer programs. However most of the discussion has focused more on soundbites such as "corporate welfare" and the government picking winners and losers than on the substance of the programs. Today we have the chance to move away from what may be politically satisfying rhetoric to hearing about what the labs are actually doing.

I want to welcome our witness and I look forward to hearing what they have to say about these programs. At the risk of sounding parochial, I would like to give particular welcome to Ms. Tina McKinley and Mr. William Martin of Oak Ridge. Although Oak Ridge is not in my district, their Center for Manufacturing Excellence has assisted businesses in west Tennessee as well as through-out the Nation.

Mrs. MORELLA. Indeed you have some distinguished panelists from Tennessee, Mr. Tanner.

I'd now like to turn for an opening statement to Mr. Weldon from Florida.

Mr. WELDON. I thank the Chairwoman. I do not have an opening statement at this time.

Mrs. MORELLA. Ms. Lofgren, for any opening statement or comments you'd like to make?

Ms. LOFGREN. No, just to echo the comments already made, that the issue of transferring the intellectual wealth of this country from the labs out into the private sector is an enormously important one, and I look forward to learning more both from this panel and also from the private sector panel later on in the day to see if it needs improving.

And from all I've heard, I think it does. But also, how we might effectively do that.

I appreciate the spirit of this hearing, which I think is oriented towards making things work better, rather than being critical, if there's something that needs to be improved.

So thank you, Madam Chairwoman.

Mrs. MORELLA. A very good comment.

I'd like to turn now to the distinguished gentleman from Michigan, Mr. Ehlers.

Mr. EHLERS. Thank you, Madam Chair. I came to learn and not to speak, and so I will be very brief.

I think this is an extremely important issue that we as a Congress must address. I know many in the Congress and on this committee are unhappy with some of the technology transfer programs that have been in place.

And rather than just killing them and not looking at the replacement, I think it's very important to consider seriously what the optimum method of technology transfer would be, and try to get that in place.

I also apologize. I'd dearly like to stay for the whole hearing, and hear all the testimony. But I have another meeting I have to leave for shortly, and I look forward to seeing the results of the deliberation of this group. Thank you very much.

Mrs. MORELLA. Thank you very much, Mr. Ehlers.

Ms. Jackson Lee.

Ms. JACKSON LEE. Madam Chairwoman, thank you very much for the opportunity. And likewise, let me offer very brief comments, and applaud you and this joint hearing for a very vital point of information. Let me note the key word of "effectiveness."

I think all of us are interested in not throwing out the baby with the bath water, or not fixing what doesn't need fixing, but enhancing and improving.

I clearly believe that in this new competitive world market, and as we move toward the 21st century, this will be the industry of America. I want us to be at the cutting edge.

Let me note that we in Houston recently celebrated a partnership between the Department of Energy and the superconductivity lab at the University of Houston.

We are also very much in the midst of biomedical technology, and certainly want to be able to enhance the opportunity to translate that research to opportunities of better health for our citizens.

Madam Chairperson, I hope as I listen this afternoon that I will hear opportunities of participation with traditionally black institutions. Texas Southern University is in my community. But many throughout the nation would like very much to be participants in some of the work that's being done. And I hope there will be a sensitizing as we look at effectiveness, and the adequate transfer of technology.

So I applaud this hearing. I look forward to listening to these experts, and I think we are on a very important journey. Thank you very much.

Mrs. MORELLA. Thank you very much. I think you bring up a very valid objective of the hearing, too.

I'd now like to turn to Chairman Schiff, who chairs the Basic Science Subcommittee, which is holding this hearing in conjunction with Technology.

Mr. SCHIFF. Thank you very much, Madam Chairman. It's a pleasure and an honor to share this cochairmanship with you at this hearing.

I have a brief written opening statement. I'd ask unanimous consent that it be made part of the record.

Mrs. MORELLA. Hearing no objection, so ordered.

[The prepared opening statement of Mr. Schiff follows:]

STATEMENT OF THE HONORABLE STEVE SCHIFF
SUBCOMMITTEES ON BASIC RESEARCH AND TECHNOLOGY
JOINT HEARING ON "TECHNOLOGY TRANSFER"
JUNE 27, 1995

Good Afternoon Ladies and Gentlemen. I want to welcome you to this joint hearing on Technology Transfer. I look forward to working with Chairwoman Morella and the Members of both Subcommittees on this issue.

Technology transfer implies a movement of things from one place to another. Yet it is more than that. It is the movement of ideas. This takes place, particularly in our National Laboratories, through the interaction of people.

We place different names on this process. We have CRADAs, we have partnership agreements, we have contract arrangements, and a number of other types of working relationships. But the importance of all this -- is getting ideas to the workplace.

I am particularly interested in the way the Federal Government works with industry and vice-versa. Is there a fair set of guidelines that allows both the government and industry to benefit? Is there a level field that allows for the partnership-forming process? Are the creators of ideas and the creators of markets working together?

One of the purposes of this hearing is to review Chairwoman Morella's proposed legislation, the Technology Transfer Improvements Act of 1995. The witnesses have been given a copy and I have read their comments. There are some issues that have been raised that need to be reviewed. Overall though, there is a consensus that benefit can come of this legislation.

How technology transfer works -- is specifically important to the continued success of the National Laboratories. Because so much of what they do -- is sharing their ideas with industry, academia, and other government agencies.

I will be introducing legislation in the near future that will also have an impact on the National Laboratories. My intent is to define the missions for the labs. With well defined missions, technology transfer will be of even greater importance to the labs. The more defined the missions of the labs become, the more challenging will be their opportunities to share their ideas on a wide scale.

Continuing the Technology Transfer theme, I would like to invite everyone to a reception following this hearing from 5:00 - 7:00 p.m. Some of our Labs have set up displays on what they have been doing in the area of Technology Transfer. Refreshments will be served. I encourage everyone to please attend.

I look forward to a good exchange of ideas during this hearing. Thank you Madam Chairwoman.

Mr. SCHIFF. Just very briefly, I want to express my opinion about the real importance of this hearing. I think there are a number of our colleagues in Congress who have reservations about government research getting too close to private research, and although I do understand and share the overall view that we don't want the government to take over the marketplace agenda of private industry, it's my belief that in the modern world, competitive nature of the economy, that other countries are using all of their intellectual assets in a combined way to produce goods to win the competition for customers in the global marketplace.

And I believe that the United States should not be in this international competition with some of its most valuable and trained scientists, engineers, and other researchers, not allowed to participate in this process.

Second of all, I believe, particularly at the national laboratories, that joint research between government and private enterprise produces research results which are of joint benefit.

It's just not some kind of gift to private enterprise to have joint research between the government and business. The government achieves its goals of research in areas in which it is interested, from hardened materials to supercomputers, by sharing research from its own funded programs with private businesses interested in the same subjects.

And I just want to add that there will be a reception in room 2325 following this hearing from 5:00 to 7:00 in which a number of the participants here have sets of demonstrations of exactly what we're all talking about here.

I hope that everyone who's at the hearing will take a moment and stop by that reception and that demonstration.

Thank you, Madam Chairwoman.

Mrs. MORELLA. I'm glad that you invited everybody to the reception. It should be an excellent opportunity for some networking to go on, too.

I now am pleased to recognize Ms. Johnson for any opening statements she may have.

Ms. JOHNSON. Thank you, Madam Chair.

Let me just compliment you and the Chair of the Subcommittee on Science for having this hearing.

I am a strong believer and supporter of research, and believe strongly that we benefit in this country from public/private partnerships. So I'm delighted that we are having it, and I thank you very much.

Mrs. MORELLA. Thank you.

Mr. Gutknecht, I'm pleased to recognize you for any comments you may like to make at this point.

Mr. GUTKNECHT. Thank you, Madam Chair.

I do not have a formal opening statement. I would say that we've assembled some very distinguished panelists, and we'll hear from them. Thank you.

Mrs. MORELLA. I hope those who are here are ready to testify, and who are here in the audience recognize the fact that these subcommittees really are here for business, because nobody made prolonged opening statements except for myself.

Mr. Baker is here. I'd be happy to recognize Mr. Baker.

Mr. BAKER. I share my previous colleagues' statement. We have a great panel. I'm fully in support of the tech transfer, and I'd like to see its expansion.

I also want to see an expansion of our ability as a government to be partners with business, and to reap some of the rewards so that we can have a little fund within the government that will bring back some of the premiums from our investment and allow us to do future research as budgets get tighter and tighter.

I also look forward, as being one leg of a stool in the formerly defense labs, so we can bring some of these secrets out to the public, and benefit both from the private sector standpoint and the public sector standpoint. And we'll all benefit.

So I look forward to years and years of success through tech transfer.

Mrs. MORELLA. How true. Thank you very much.

Panel I witnesses are going to be able to provide us with historical overview and a diverse policy perspective of federal technology transfer policies relating to our federal labs.

Government, industry, universities, and states, and a number of you have worked very closely with us on the Science Committee in the past, and we appreciate that very much.

As I mentioned, I think we're going to try something different because we have so many panels. We're going to allow members of the subcommittees to ask questions of you directly. And as I mentioned in my opening statement, your opening statements will be included in total in the record.

And I'm going to ask if each of us on the subcommittees will be given five minutes, not to exceed it. Then we can come back for a second round if that is necessary.

I'll start out with a very direct question. What do you think of the current status of the federal technology transfer laws, and whether you think they're deficient? If they are, what can we do about it, and where are they successful?

I could start anywhere, but I'll do it alphabetically with Mr. Allen.

STATEMENT OF JOSEPH P. ALLEN, DIRECTOR OF TRAINING, MARKETING AND ECONOMIC DEVELOPMENT, NATIONAL TECHNOLOGY TRANSFER CENTER

Mr. ALLEN. Thank you very much for inviting us to testify today. When we testified last year, things have certainly changed a lot up on the Hill since then.

But this committee really deserves a lot of credit. This has been a work in progress that goes back to the '70s. It's always been a bipartisan effort. What we're really looking at is creating a U.S. model of economic competitiveness. It's not simple to do.

Actually what I'd like to do is quote back even some of the statements that the members made just a minute ago. I think the best characterization is what Mrs. Morella just said, opening up. This is an untapped resource.

We have made significant progress in 10 years, as Mr. Tanner said. If you look at the economic results coming out of the federal lab system, they're big numbers. These are numbers that 10 years

ago didn't exist. There was very little coming out that was really of direct economic benefit.

The number of cooperative agreements is up. Exclusive licenses is up. Royalties is up. And that's all positive.

Having said that, though, when you look at the contribution of a $35 billion system, which is our federal lab and university system, can make to the country, then we're just getting started.

I would like to commend the Chair for her legislation, which I think is going to be a big step forward.

There are three bases of our model. It's market-driven, which means decentralization. There are incentives provided to the laboratories and the scientists to succeed, and there's intellectual property given to the companies who come and take this research out, which usually is a long way from the market, and be a successful commercial product.

Your legislation strengthens all those incentives, and I would like to commend you for that. I think this legislation deserves support.

The thing I would like to caution is, after it's enacted, look at the implementation. In my opening statement—I don't want to elaborate on this too long. I think one of the biggest threats is too much process.

When you had the industry people testify last year, the one thing they said loud and clear to you was, "Give us certainty if we have a deal or not. Don't keep this thing going on. Don't have negotiations going on between you and your lawyers that go on and on and on. Let us know if we have a deal."

And I think you've laid a solid foundation. Your legislation builds on it, and I think with some good oversight by this committee, which is certainly something that you have the authority to do, there's no reason why the system can't work.

I'd also like to add if I could, just one second, Ms. Jackson Lee hit something which I'd like to comment on. We started in the new program to bring some of the best and brightest students from historically black colleges into this system.

There are very, very few what I would consider really highly skilled public entrepreneurs. We need more. This is the time to get in on the ground floor. This is a national policy effort. This is not just tech transfer. It touches on everything in this whole economy. Thirty-five billion dollars is too big just to have in one little segment.

So again, I'd like to commend you.

I think we've come a long way. We've frankly got a long way to go.

[The prepared statement of Mr. Allen follows:]

TESTIMONY OF

JOSEPH P. ALLEN, DIRECTOR

TRAINING, MARKETING & ECONOMIC DEVELOPMENT

NATIONAL TECHNOLOGY TRANSFER CENTER

TO THE

HOUSE SUBCOMMITTEES ON BASIC RESEARCH

AND TECHNOLOGY

JUNE 27, 1995

Thank you for providing me with this opportunity to testify today and share with you some of my thoughts about improving the commercialization of federal R&D by U.S. industry.

I believe that the current laws allowing universities and federal laboratories to partner with U.S. industry are a solid basis for future progress. Legislation like the carefully crafted bill by Representative Morella will greatly enhance this process.

The greatest challenges that I see are: 1. the tendency of bureaucracy to re-centralize authorities through cumbersome processes; and 2. the danger that our impatience and fear of slow movement leads us to make ill-advised fundamental changes in technology management systems when what is really needed is fine tuning.

With the new budget limitations the Government faces and an increasingly competitive world marketplace, now is the time for bold experiments-- not bureaucratic timidity. Congress and the Administration must recognize this means that not every experiment will be successful. We should not punish prudent risk taking. It is the hallmark of our society.

With freedom must come accountability. Universities and federal laboratories alike should have plenty of leeway for putting market-driven principles to work in

creative new ways. Like the proverbial good steward in the Bible, there must also be an accounting for how this investment is managed.

Congress and the agencies have every right -- and indeed, a duty-- to demand accountability in the budget and oversight processes. This does not mean micro-management or undue legal restrictions which dampen the "fuel of interest for the fires of genius" as Abraham Lincoln rightly noted constitute the basis for our intellectual property system. Linking freedom and accountability also allows "best practices" to evolve in locally initiated experiments. These are the best "laboratories" for any market-driven system. Additionally, decentralization insures that experiments that fail do not spread. In a centrally managed system failures in planning are disastrous.

Measuring immediate success is also very difficult in a system which routinely performs research that is usually far removed from immediate commercial application. While not perfect, CRADA and license counting is at least an industry-driven measure. Royalty returns are also a good indication that there is life in the system, although the universities have found that it can easily take 7 years for a good technology to move from the university to the commercial market. We should also look at the investments that companies are making to tum federally-funded R&D into commercial products.

We should consider how national laboratory and university researchers are integrating real-world needs into the design of applied research projects undertaken to meet agency missions.

Much more difficult to measure is the economic value of technical assistance which the National Technology Transfer Center sees as by far the most demanded laboratory product in the calls we receive from U.S. industry.

Unless we devise objective methods for evaluating the economic benefits derived from the spectrum of laboratory- university- industry- state government interactions, it is difficult to make the critical judgments that the Administration and Congress must now face in strategically allocating a shrinking federal budget. Yet we recognize the process of economically linking our public and private sectors is a key to our competitiveness. I cannot pretend to have ready answers to these hard questions.

We are now in the midst of a historic cultural change. The Government process is risk averse. Innovators are usually viewed with suspicion. This is changing, but is very much still with us. Because we have not adequately trained our public sector how to successfully employ the revolutionary tools encouraging cooperative research with our private sector, there can be an over-reliance on process. This can make the negotiating process-- which is always complex-- a nightmare. The need for training is a serious one. Very few of our federal

laboratory or university employees understand the dramatic nature of the changes brought about by the technology transfer legislation this Committee largely authored. The National Technology Transfer Center has made training a central part of our mission. We are working with the U.S. Navy and NASA to make comprehensive training courses available in their facilities.

The Association of Federal Technology Transfer Executives (AFTTE), of which I am honored to be President, seeks to raise professional standards and trade best practices in technology management across agency lines. The Federal Laboratory Consortium has long seen the need for training as an important part of its function and worked hard toward that goal. Such efforts are critical to our success.

It is frankly remarkable to me that we are even doing as well as we are given the few resources that have been invested in teaching the laboratories and universities how to master techniques that up until a few years ago were not innovative, but illegal.

We should now focus on mastering the best practices for using the technology management system that has been painstakingly created over the last 15 years. This decentralized technology management system, largely crafted by your Committee, can quickly respond to a dynamic private sector if it is allowed to function as designed.

Along this line, I would also like to commend Representative Morella for including an amendment to the pending bill re-establishing decentralized management of public sector technology for the Advanced Technology Program. The current decision to take technologies away from universities if they are partners in the ATP program is an example of a Washington solution looking for a problem. Such arbitrary decisions undercut the very foundation that has made our universities the world leaders in finding commercial partners for their R&D.

As I mentioned last year in my testimony, this Committee largely invented the modern federal technology management system . Starting in the mid 1970's when few even recognized this as a serious competitiveness issue, your Committee started examining federal technology management procedures using a revolutionary new yardstick-- that the U.S. taxpayers deserve an economic as well as scientific return on the $35 billion invested annually in our unparalleled federal laboratories and universities. This has been a difficult process, but the passage of the Stevenson-Wydler Act , the Bayh-Dole Act, and the Federal Technology Transfer Act forged a strong chain linking our public and private sectors in economic partnerships.

You designed a system drawing on the American genius for entrepreneurship rather than trying to impose a European or Asian model on us. This was a bold

move at a time when many were wondering if our best years were behind us, suggesting that we might as well settle for second place-- or worse!

Increasing the commercialization of the technologies derived from the funds invested in our federal laboratories and universities has been a bipartisan goal for many years. The principles that your Committee enunciated were embraced by President Reagan as the keystone of the policies established in Executive Order 12591 establishing a clear mandate to the agencies that these laws were to be vigorously implemented.

The policies underpinning the current laws are providing economic returns. Since enactment in the 1980's, we have seen steady increases in successful university and laboratory licenses, royalties and collaborations with U.S. companies. It is now common to see high technology start-up companies forming around our universities. DOE should be commended for its goal of encouraging the same phenomenon around its laboratories.

It is now time to expect this progress to increase even more dramatically. However, we should not forget that this represents a radical change to a system that has been functioning since World War II. You do not change a complex system like the federal R&D structure overnight.

7

Another measure of our success is that our European and Asian competitors are now studying our models to learn how to make their own public research institutions more effective technology managers.

This is not to imply that the current system is perfect, but that we have come a long way from the 1970's when it was difficult to find any companies willing to testify that our universities or federal laboratories had any real economic benefits to offer.

We are entering a new era of budget austerity combined with the winning of the Cold War that is forcing a re-examination of the federal R&D system. The missions of the agencies, their laboratories, and our research universities are undergoing their most fundamental re-evaluation since Vannevar Bush gave his recommendations to President Roosevelt on the role of Government research in 1945. This is obviously a much larger question than just technology transfer, but I suggest that in this review we not lose sight of the principles that were first enunciated in this very room.

These are the maxims underpinning the American technology management system that have held us in good stead and should be kept in mind as we examine what contributions our public research institutions can make in the future. They are the following:

8

1. Decentralized management of technology by the creating institution is by far the most effective method for prompt commercialization.

This idea ran completely contrary to the conventional wisdom of the 1970's that we needed to imitate the centralized Japanese or European models. Luckily, Congress wisely chose a market driven, decentralized model relying on the creating universities or federal laboratories as the best public stewards rather than Washington. This model is working, but, like any federal system, it needs to be dredged from time to time to keep it from filling up with process that is so dear to the bureaucrat's heart.

Headquarters should set guidelines, clarify policies, and help identify best practices. In other words, serve as an expediter for the system. When Washington tries to micromanage the actual process of technology management, it impedes the ability of the market to function. Similarly lawyers must serve staff functions. They are poorly trained to be entrepreneurs. Systems designed by attorneys have plenty of brakes, but few, if any, accelerators.

The wisdom of the market runs significantly ahead of agency policy making. If agencies determine the missions of their laboratories, give them their budgets, provide training on how to use the laws, and then get out of the way, the entire process would speed up significantly.

2. **Real incentives for the institution and its scientists to pursue commercialization must be provided.**

At a time when budgets are shrinking and the staff is being asked to do more with less, there must be increased rewards both for the facility and the researchers for success. The laws wisely provide that royalties from successful licensing and Cooperative Research and Development Agreements (CRADAS) are returned to the laboratory, universities and their scientists. Representative Morella's new legislation rightly strengthens this incentive system.

Technology commercialization is hard work. It must be rewarded. This should extend to the agency budget process. Such actions speak much louder than policy proclamations in convincing the laboratories and universities that technology transfer is indeed a priority and not a fad.

We should also look to make sure that our successful federal laboratory deal makers are provided clear career paths. There is a danger since technology managers are neither scientists nor traditional administrators that they can get lost in the federal promotion system. Brokering deals is hard work anywhere. It is especially hard in the public sector.

After 5 years or so of carrying this burden, many of the best technology managers have been beaten down by the system or decided there must be an easier way of making a living. I believe that if you look at the institutions where technology transfer is succeeding you will find a champion who has accepted this burden. There needs to be a light at the end of the tunnel for these unique individuals that is more than an oncoming train!

3. **Sufficient intellectual property protection must be provided so that the industrial partner can take the concept from the laboratory or university to commercialization.**

Again, Representative Morella's bill provides needed assurances to U.S. companies that they will have a guaranteed degree of exclusivity for technologies that arise from collaboration with our laboratories in order to justify taking technologies promptly to market. This provides a needed "floor" so that, regardless of which agency a company is dealing with, the needed degree of intellectual property protection is afforded.

I suggest that you closely monitor the implementation of these amendments when this legislation is enacted as it deserves to be. One of the frustrations that you heard loud and clear from industry last year in the House and Senate hearings is that industry needs a quick decision on whether they have a deal. Too many times the laboratories are spending time negotiating, not with the

company, but with their own headquarters policy office or legal staff. It would seem that if someone is competent enough to run a multi-billion dollar federal facility, they should be able to complete a million dollar CRADA without having to constantly get permission from above.

Similarly, "model agreements" should be just that. The laboratories should be able to modify these to meet the needs of the industry partner without slowing down the entire process.

John Preston, who is appearing on the panel with me, has a brilliant analysis of the need to create "passionate" deal makers in any public institution. John also warns how the prime killers of passion are bureaucracy, lawyers and committees. All of these have places in the federal system, but, if we have decided that the time has come to "put the pedal to the metal" in commercializing our public R&D, these entities cannot be allowed to control the system.

This does not require new laws as much as Congressional oversight to keep the agencies on the straight and narrow.

I would like to close by citing some of the evidence that the National Technology Transfer Center is seeing in our everyday operation that U.S. industry is indeed reaching out to our federal laboratories and universities for assistance. Our

system has received more than 10,000 phone inquiries from all over the country from companies looking for help. Working closely with the Federal Laboratory Consortium (which is ably represented today by its Chair Tina McKinley), and the Regional Technology Transfer Centers, these inquiries are linked with the federal R&D system.

Here is what we are seeing:

o 72% of our clients are small or medium sized companies (having less than 500 employees). These are precisely the kinds of companies that create the most new jobs, yet have historically had the most difficult time accessing the federal system.

o 44% of our clients are manufacturing firms. One of the greatest assets of the federal laboratory system is its expertise in solving technical factory floor problems. With our manufacturing base under continuous assault by foreign competition, having the ability to tap into the know-how of 700 laboratories with one-sixth of all of the United State's R&D scientists and engineers is a great competitive advantage. With modern communications capabilities we routinely find solutions to client problems in federal laboratories or universities thousands of miles away from the client.

o The technologies being sought cover the complete spectrum of R&D. Most of these also represent the high growth technologies that any industrialized country must master if it hopes to remain prosperous.

A good illustration that the federal laboratory system truly is national is shown by looking at the requests that we refer to laboratories in Maryland and New Mexico. These states obviously receive significant benefits from the world class facilities in their backyards. The degree of assistance that these facilities provide to other states is not so obvious. About 15% of all of the referrals we make to the entire federal laboratory system go to facilities in Maryland or New Mexico. I have attached a map of the U.S. showing the states these companies are calling from. The entire country is deriving real economic benefits from the federal laboratories and universities located in just two states. Such examples can be repeated for virtually every major federal laboratory.

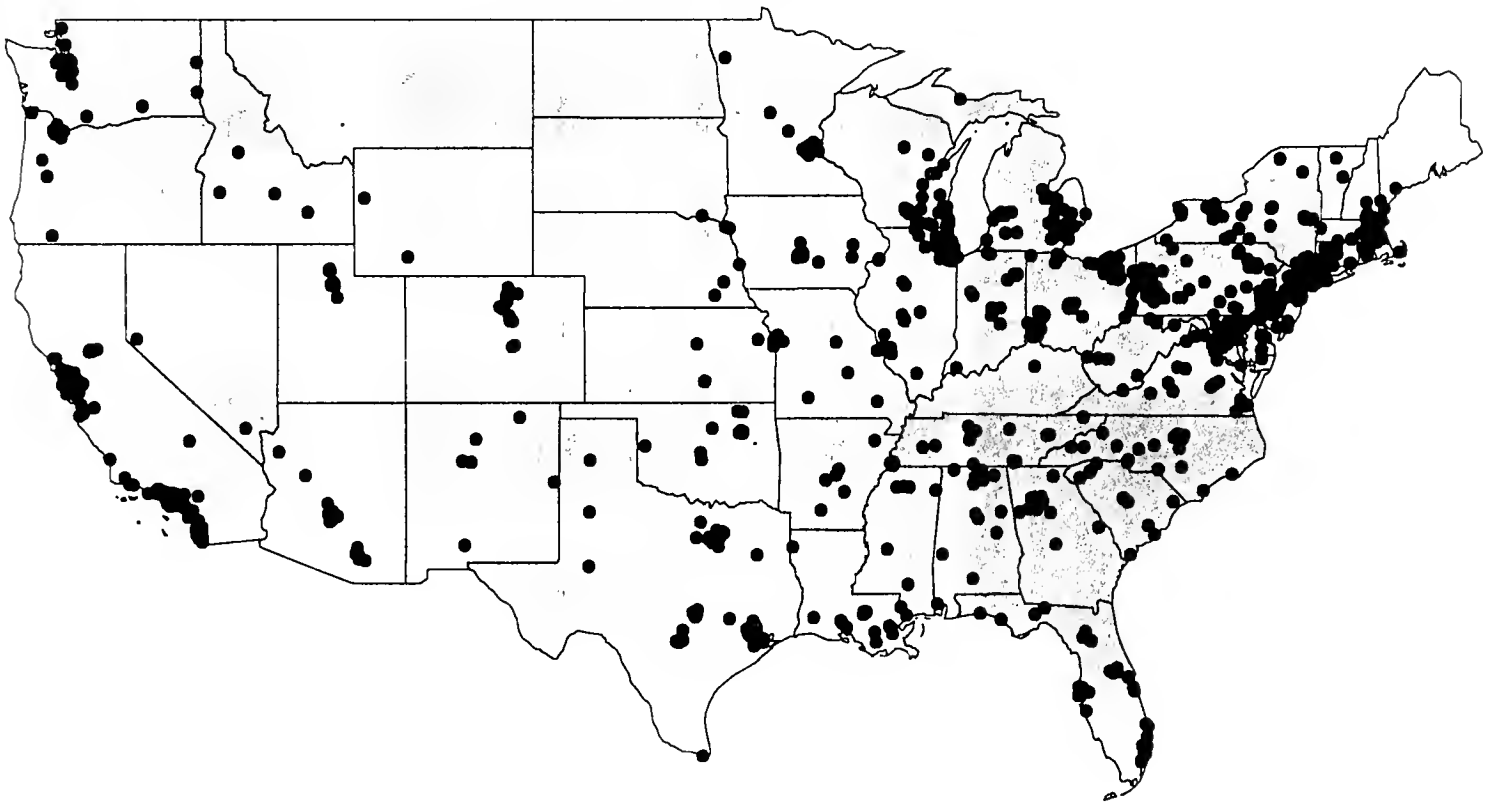
We must continue to improve U.S. industry's ability to instantly tap into the federal R&D system. Our ability to provide information must keep up with America's ability to access it. This Committee is well aware of the proliferation of persons with Internet capabilities. At the NTTC, the volume of log-ons to our electronic services has exploded. Our electronic gateway to federal research information has been accessed to retrieve more than 100,000 documents in just a few short months. That is evidence of the fact that our growing nation of Internet users are looking for electronic data without the red tape attached.

In conclusion, the ultimate goal I envision is the ability to link our federal laboratories, universities, state and local business assistance programs strategically with U.S. industry in locally led initiatives. This is playing to our competitive strength. The task is certainly not easy, but the benefits are enormous.

Thank you again for inviting me to share these observations with you.

Location of Companies Referred to Maryland Labs

Data Through 1st Quarter 1995



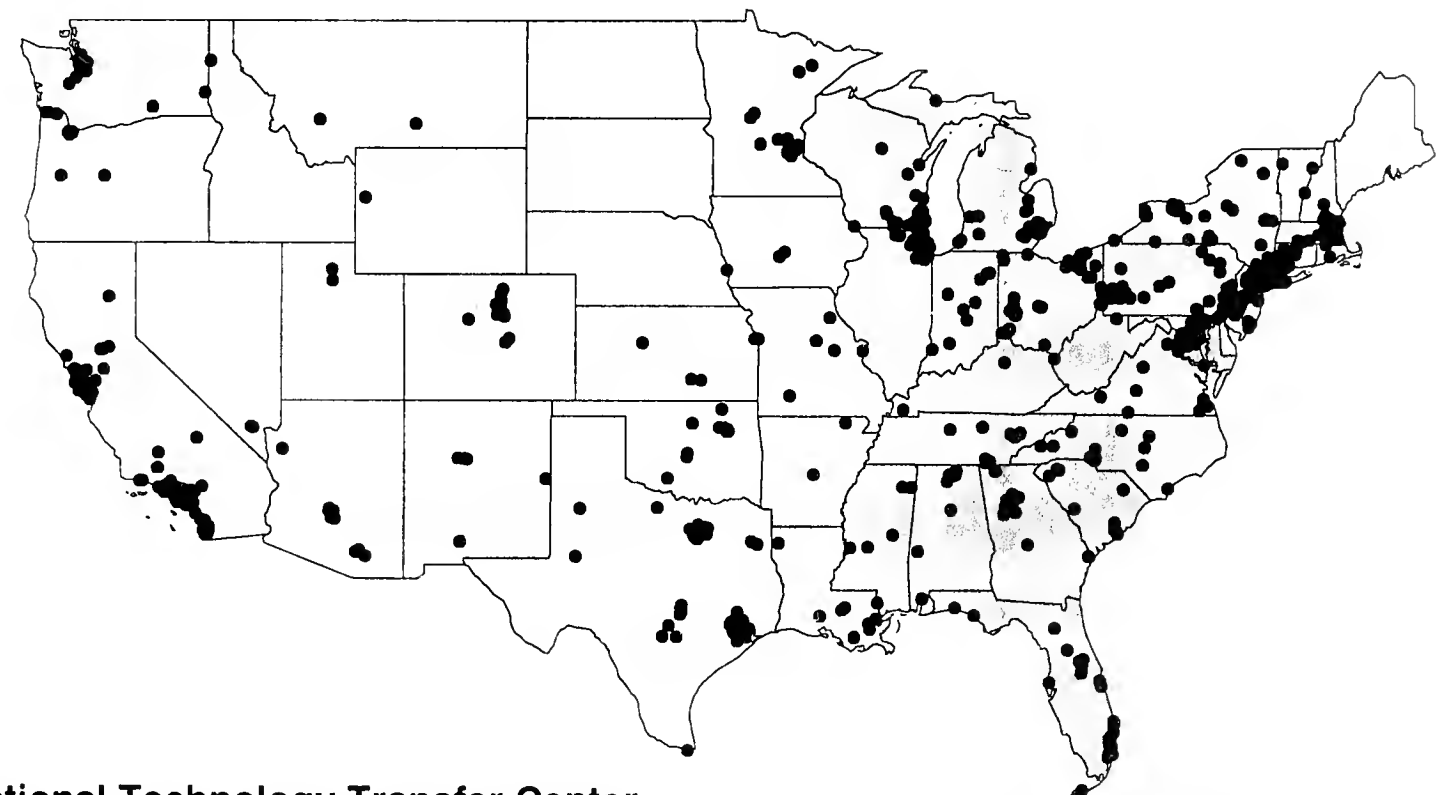
National Technology Transfer Center

Wheeling Jesuit College * Wheeling, West Virginia 26003

Total Referrals to Maryland Labs=1943

Location of Companies Referred to New Mexico Labs

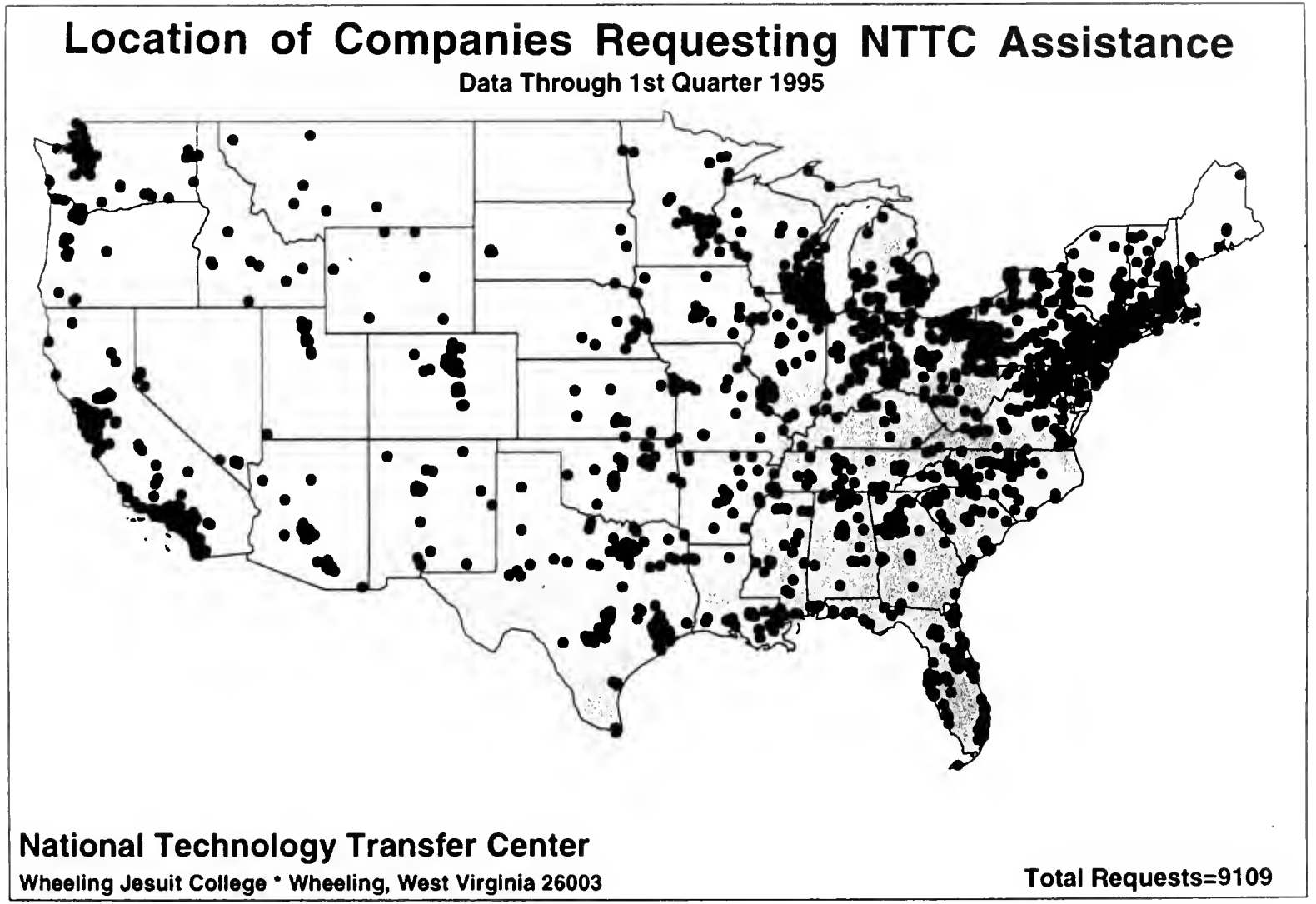
Data Through 1st Quarter 1995



National Technology Transfer Center

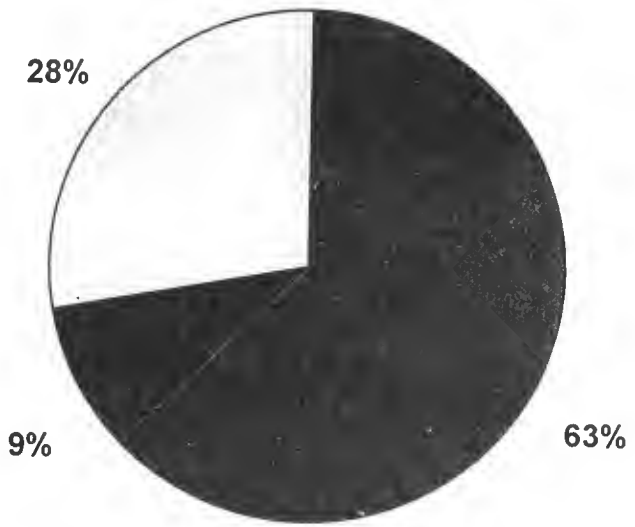
Wheeling Jesuit College * Wheeling, West Virginia 26003

Total Referrals to New Mexico Labs=1259


Location of Companies Requesting NTTC Assistance
Data Through 1st Quarter 1995
National Technology Transfer Center
Wheeling Jesuit College • Wheeling, West Virginia 26003
Total Requests=9109

NTTC Clients by Number of Employees

Data Through 1st Quarter 1995



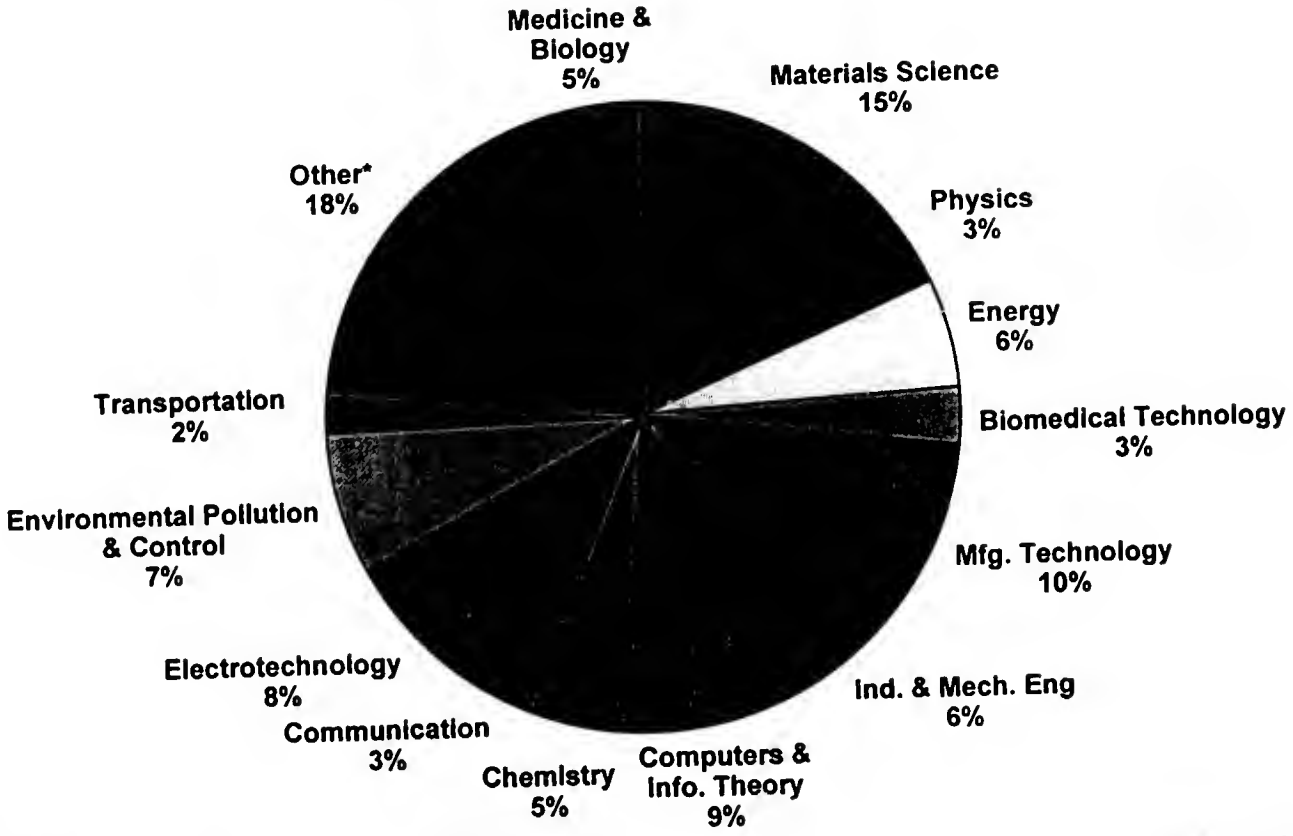
Small	Medium	Large
1-100 Employees	101-500 Employees	Over 500 Employees

Total Clients = 4982

National Technology Transfer Center Cli 2

NTTC Requests by Technology Area*

Data Through 1st Quarter 1995



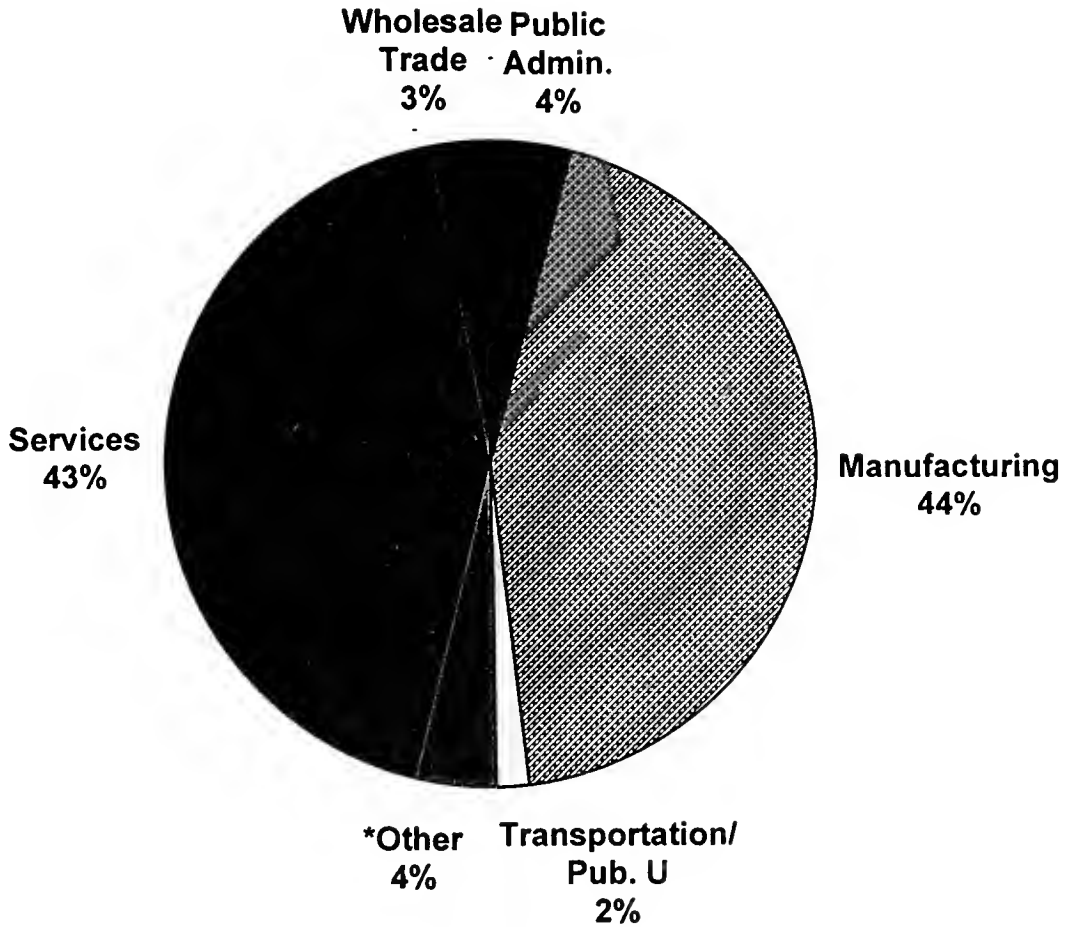
Total Requests = 9109

**Other Includes Categories with < 2% of Total

*Major NTIS Classes

NTTC Clients by SIC Division

Data Through 1st Quarter 1995



Total Clients = 5068

*Other Includes Categories with < 2% of Total

Mrs. MORELLA. Thank you, Mr. Allen, for your expertise and experience.

Ms. McKinley.

STATEMENT OF TINA McKINLEY, CHAIR, FEDERAL LABORATORY CONSORTIUM, OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Ms. MCKINLEY. Thank you, Chairwoman Morella.

I concur with Joe's comments. It is quite an honor to be present at this table today, and I thank you for the opportunity. From the perspective of the Federal Laboratory Consortium and our 16 member agencies, and the 600-plus laboratories that they manage, there has never been a better time to transfer and jointly develop federal technologies.

The legislative climate is more user-friendly than it has ever been before, and your proposed Technology Transfer Improvements Act of 1995, we believe, will increase and improve our effectiveness and the speed with which we can transfer technologies.

We believe, as the laws that you mentioned earlier have stated, that technology transfer has got to be a part of the way that we do research and development in the federal tech transfer and the federal R&D communities.

That means that it has to be a part of the way we approach research. It has to be a part of all of the things that we do. We have to look for and seek out opportunities to work with private partners from the very outset.

How do we do this? We do this partly by providing comprehensive information in a comprehensive manner, recognizing fairness of opportunities. We remain constantly aware that successful transfer of technology must be two-directional and it must also meet the technical needs of prospective partners.

Finally we recognize as a consortium that's been in place now for 20 years and represents a very diverse society of federal R&D, that there will always be complex issues.

We suggest to the distinguished members in this room that many of these issues can best be addressed by identifying best practices and sharing our experiences with one another, and that we do not necessarily need a tremendous amount of legislation to be passed by the Congress.

I appreciate Joe's comments. The federal R&D community represents a tremendous resource base. And we do have more transfers going on than ever before. We are coming up the learning curve. We are sharing our lessons learned. And frankly, we find it to be an exceedingly exciting time to be involved in federal technology transfer.

[The prepared statement of Ms. KcKinley follows:]

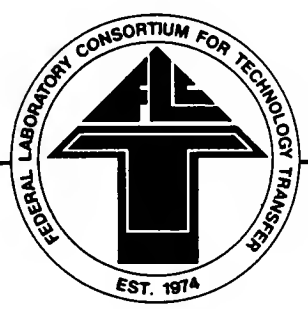
Lessons Learned in Technology Transfer:

20 Years of Federal Laboratory Consortium for Technology Transfer (FLC) Experience

Tina McKinley, FLC Chair

Prepared for the Committee on Science
Subcommittee on Technology & Subcommittee on Basic Research
U.S. House of Representatives

June 27, 1995

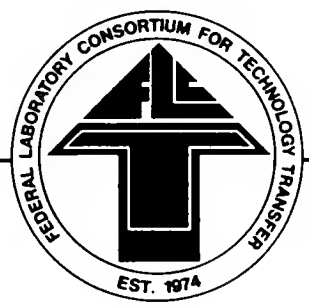


THE FLC MISSION:

To promote and facilitate the rapid integration of federal laboratory expertise, research and technologies into the mainstream of the U.S. economy.

FLC MEMBER AGENCIES:

Central Intelligence Agency
Department of Agriculture
Department of Army
Department of Air Force
Department of Commerce
Department of Energy
Department of Health and Human Services
Department of the Interior
Department of Justice
Department of Navy
Department of Transportation
Department of Veterans Affairs
Environmental Protection Agency
National Aeronautics and Space Administration
National Science Foundation
Tennessee Valley Authority



Lessons Learned in Federal Technology Transfer:
20 Years of Federal Laboratory Consortium Experience

Tina McKinley, Chair
Federal Laboratory Consortium

Prepared for the Committee on Science
Subcommittee on Technology & Subcommittee on Basic Research
U.S. House of Representatives
June 27, 1995

Introduction

It is a privilege to appear before you today to comment on the Technology Transfer Improvements Act of 1995. In their preparatory discussions with me, the Subcommittee staff also asked that I share some of the experiences and lessons we have learned in the 20 year history of the Federal Laboratory Consortium. It is my pleasure to do so in my spoken remarks and, in more detail, in my written testimony.

FLC Comments on the Technology Transfer Improvements Act of 1995

Overall, we believe that this legislation will contribute to the effectiveness and speed of federal technology transfer. We appreciate the expanded guidance the legislation will provide with respect to the use of resources received through cooperative research and development agreements and agree with its intent to provide greater flexibility to the federal agencies and laboratories to use these resources in ways that they believe best support their technology transfer activities. We note, with appreciation, that many of our past suggestions have been incorporated into this 1995 version of similar legislation sponsored previously.

We appreciate the incorporation of our earlier recommendation that collaborating parties be given the option to choose an exclusive license for a field of use. As we noted previously, exclusive licenses for fields of use are becoming the "best practice" evolving among government laboratories. Laboratories grant exclusive licenses to companies for one or more fields of use with performance criteria written into the licensing agreements and the result is wider possible commercialization of technology because the commercial positions of private companies are protected while also preventing unproductive monopolization of rights to technology. If performance criteria are not met, exclusive licenses may be revoked and the technology licensed to another company. For intellectual property developed under CRADAs exclusive licenses for specific fields of use are appropriate, because CRADA partners usually commercialize

a technology for a specific product and may have little or no capability or intent to market and license it for other uses.

We believe that other parts of the proposed legislation make substantive changes in our present way of transferring technologies and we believe that these changes make an important contributions to our ability to negotiate with potential partners.

Unique to this bill is a proposal to give our member agencies authority to use funds received from collaborating parties to hire personnel to perform cooperative research. We welcome this opportunity and ask that you consider broadening the language further so that we can use these funds to support the overall technology transfer support base. We ask that the words "to carry out the agreement" be deleted so that employees hired with collaborating party contributions can work on a range of technology transfer related activities. With this change, for example, a productive staff member could continue to work on technology transfer activities after the cooperative research has been completed so long as the laboratory has sufficient funds.

The proposed legislation provides expanded ability for federal agencies and laboratories to apply the resources received through technology transfer agreements to further their scientific missions. We believe this will strengthen many laboratory and agency technology transfer programs.

In our comments submitted to Chairwoman Morella on May 24, 1995 we included several other items which I will not go into in detail today. I would like to take the remainder of my time to share some observations and experiences from the Federal Laboratory Consortium. First, a little background.

The Federal Laboratory Consortium for Technology Transfer (FLC)
The FLC is a viable, working network of 16 federal agencies and the more than 600 research laboratories and centers they manage. To the best of my knowledge, it is the only productive infrastructure through which all federal organizations which share a research and development mission contribute ideas, expertise and experiences in transferring federally-developed technologies and collaborate on broader opportunities. The FLC is as diverse as the federal community; through our network, consensus emerges when it exists and interested parties have the opportunity to work with, and gain access to, the entire federal research and development system.

Origins of the FLC
Twenty-four years ago the Navy wanted to transfer a radar system to the Federal Aviation Administration and the technical staff within the laboratories involved did not know how to make it happen; just transferring dollars to fund new applications of the technology from the lab of one agency to another created people and accounting problems that stymied the most devoted technology transfer advocate.

In the late 1960s and early 1970s, federal laboratories were not particularly well known for their interest in working with one another, or with other organizations outside of their realm. But there was a core of technical staff at the Naval Weapons Center, the NASA Jet Propulsion Laboratory, Rome Air Development Center and a few other laboratories who were actively providing information on technologies that had the potential to address civilian problems in law enforcement, civilian aviation, three-dimensional mapping of air pollutants and municipal transportation and communications systems to a range of state and local organizations.

This core of believers established the DOD Laboratory Consortium for technology transfer in 1971 as a way to strengthen their individual efforts. In 1974, at the request of NASA, EPA and the Atomic Energy Commission laboratories, the DOD Consortium evolved into the Federal Laboratory Consortium for Technology Transfer.

Twenty years ago, it was virtually impossible for federal laboratories, particularly those engaged in defense-related research, to consider working with industry. Interactions with companies were considered far more risky than cooperative efforts with other federal, state and local entities because of the daunting mass of regulations, instructions and standards that governed laboratory technical, contractual and organizational obligations.

Twenty years ago, when we talked about technology transfer, we usually meant spin-offs. Technology conversion was the term we used to explain the process through which technology developed for one purpose, in one place for one user was also found to be useful to another user in another place, often for another purpose. We did talk about technical assistance back then, but we did so almost exclusively in the realm of technical advice for state and local governments or other federal agencies. These days we talk much more about cooperative research and development, and its subsequent "spinback" to the federal laboratory and agency research mission. And, we find that technical assistance has become very important to businesses, as well as state and local, and increasingly, regional, organizations. Today's legislative and policy climate allows us to use more mechanisms, in different ways, to work with external partners, particularly those in the private community.

What Have We Learned?
What have we learned about transferring federal technologies during our history? Recognizing the risk of summarizing so broadly that nuances are sometimes lost, I would like to share some of the things that we have learned through experience:

(1) **Technology is volatile**. Technology begets technology through communication. To contribute its full value to society, technology requires social interaction. It must inspire further development, or competitive technologies, and, if it is to be found commercially viable, it must be brought to public judgement through the market place.

Like commercial technology, the technology available from federal laboratories is more than data in computers or drawings on a shelf. It is also knowledge in the minds of creative and thoughtful researchers. One of the reasons, we believe, why we have seen such a significant growth in technical assistance as a component of technology transfer over the past decade, is due to a growing recognition of the value of the expertise resident within federal laboratories. Today, an increasing number of private partners, particularly small businesses, are seeking access to this expertise in a manner that rarely involves patents, licenses, or other formal mechanisms.

(2) **Both sides should benefit.** Barry Bozeman from Georgia Tech recently completed an analysis of 229 federal laboratory-industry interactions between 219 firms and 27 federal laboratories. Eighty-nine percent of the companies agreed that their interactions were a good use of their resources. A general finding of the study was that, by virtually any of the measures used in the analysis, the lab-industry interactions were in aggregate, believed to be a "good investment". Today's emphasis is on establishing partnerships that support laboratory and agency missions and strengthen the U.S. economy. The relevance of federally funded technology to the U.S. private sector must be two-directional; clear and substantive benefits must accrue to both participants. Where dual benefit is not apparent, federal laboratory resources may be made available to the private sector through a fully cost-recoverable, work-for-others (or contract research) arrangement, but the provision of these resources should not be federally supported.

(3) **Technology Transfer is a team sport.** The old truism that technology transfer is a body contact sport holds, but it is a team sport, not one based on individual competition. Our partner organizations have a responsibility to be honest about their agendas, our laboratory representatives must ensure that their research and development missions are being met; all must be willing to negotiate in good faith. On both sides of the table, the personnel represent a broad range of talents and expertise that has grown increasingly sophisticated over the past years. Our most active participants in the FLC are not just technology transfer personnel, but also legal staff, public affairs personnel and contracting and procurement staff and their diversity is mirrored in the negotiators we work with from the private sector.

(4) **Cultures are not so very different**. Industry is not the only sector with a bottom line. Federal laboratories and agencies share a bottom line as well and it is clear: how well does the work being performed address the mission requirements established by Congress and the Administration? We have learned that technology transfer is successful only when all partners can show that the activities contribute to their bottom lines. This means that the underlying motivation for working together must be clear from the outset and that our negotiators, and theirs, must recognize why each party is attracted to the effort in the first place.

(5) **Jointly planning technology transfer versus add-on activities.** We have learned that tacking an industry conference on at the end of a long research effort and calling it technology transfer is not sufficient. To optimize the value to the taxpayers of our federally funded research and development, we must consider, from the outset, how best to leverage each partner's contributions of dollars, expertise, and equipment. Today, we acknowledge openly that our external partners do some things better than we ever will, we see more cooperative efforts within the federal community than ever before, and we recognize that technology transfer means bringing new ideas into our laboratories as well as transferring them out. Technology transfer must be part of the way we do business in the federal research community. This means we need to continue to seek out, define and share best practices and we must be willing to tolerate new approaches to evolving situations.

(6) **Top management support is critical.** I asked several of the pioneers in federal technology transfer to name one thing that they believed to be most important and they all gave the same response: open and active support from top management. They explained that they did not mean passive acceptance, but stated and written endorsement of the transfer efforts and key players. Technology transfer advocates within the federal laboratory community are entrepreneurs, in their own way. And like any innovative problem-solvers, they must be encouraged to find ways to make things happen. Only if senior personnel are held accountable for transferring the technologies they develop are they likely to develop an overall technology transfer vision for the organization that will allow innovative approaches and encourage laboratory employees to think beyond a single application of their research and development.

(7) **The legislative climate is more user-friendly than ever before.** Appendix I includes a summary of the major legislative themes in federal technology transfer that we track for FLC member laboratories and agencies. We view these trends as indicative of continuous improvement that is increasingly outcome oriented. The result is a more conducive climate for technology transfer than we have ever known. We do note, however, some potential risk of reaching a trade-off between flexibility and compliance if the legislative framework becomes much more specific.

(8) **It is important to recognize successful transfers.** Laboratory investigators are being recognized by their agencies for timely and innovative approaches to technology transfer opportunities. For the past ten years we have awarded FLC Awards of Excellence to technical staff within federal laboratories and agencies who have successfully transferred their technologies. Appendix III lists the recipients of the 1995 Awards. We find that our member laboratories and agencies have placed increasing importance on applying for and receiving these awards, particularly in the past five years.

(9) **There is more value in flexibility than standardization.** After nine years of experience implementing more than 3,500 Cooperative Research and Development Agreements (CRDAs or CRADAs), our member laboratories and agencies have grown beyond the need for standardized guidance. On the contrary, our needs now are for maximum flexibility. We know well those CRDA provisions which can be easily streamlined, and those which continue to require large amounts of time and attention. At the same time, we recognize the critical need to provide our external partners with similar options, regardless of which agency manages the laboratory partner. We also recognize that a CRDA written for technical assistance purposes may need to be substantially different from one focusing on an existing patent. So our emphasis shifts beyond standardized guidance to defining common option language for critical CRDA provisions associated with areas such as intellectual property ownership, product liability, fairness of opportunity, marking and protection of proprietary data, keeping and auditing CRDA records, and protecting technical data. Common options, based on experiences in the federal community offer both flexibility and consistency.

(10) **There will always be complex issues in federal technology transfer**. The issues are complicated and evolving. For the most part, we believe that they are best addressed through policy and experience. As history has shown, however, legislation has played an important role in dealing with complex federal technology issues. Our member agencies continue to refine policies to address many of these issues, others can be refined by sharing best practices across the laboratory community. When one compares the policies ten years ago with what we know now, there is definite progress. What are some of the issues we are addressing today? Here are a few:

▪ Performance Metrics. There is no issue more critical to federal technology transfer in 1995 than determining and using measures to assess its value to all participants. Disagreement appears to exist in two dimensions: (1) What types of measures truly represent the impact of technology transfer efforts? (not just the process, which is far easier to evaluate) and (2) Which measures are sufficiently sound that they can be used across a wide range of varying technology transfer efforts? (for example, a personnel exchange program within a government-owned, contractor-operated laboratory versus a CRDA between a government-owned, government-operated laboratory and a large industry, or providing technical assistance to a local small business versus licensing an existing patent to a large international firm). The volatility of technology also contributes to the difficulties of precisely measuring its transfer. The FLC agrees that the definition and adoption of performance metrics are of the highest priority and we are working with our member laboratories and agencies in this area.

▪ Facilities Reuse. The recommendations of the Department of Defense Base Realignment and Closure Commission, together with calls for similar decision-making bodies for other federal laboratories, reveal substantial changes in the structure of the federal research and development community. What, if any, is the optimal role for

technology partnerships when a federal facility is to be turned over to another organization? At what point does the federal mission, and responsibility for ensuring the broadest possible use of federally funded research results, cease to exist?

▪ Fairness of Opportunity. Large companies, we noted, often have sufficient resources to assign one or more employees to technology-seeker positions, including searching for CRDA opportunities with federal laboratories. Small businesses generally lack these resources, yet they provide a significant share of new products and new jobs. FLC member laboratories and agencies have made concerted efforts to find ways to meet the needs of small businesses. These efforts range from specially developed CRADAs to technical assistance arrangements and include special training and intellectual property agreements. Initial proof that these efforts are succeeding is found in the substantially increasing number of technology transfer arrangements between federal laboratories and small businesses. In calendar year 1994 for example, 80% of the calls placed to the FLC Laboratory Locator Network were from small businesses seeking general and technical information.

▪ Regional Alliances. A sizable number of organizational alliances has emerged over the past five years. Players include federal laboratories, state and local governments, technology broker organizations, regional technology transfer organizations, community colleges, and chambers of commerce. At the local level, distinctions between technology transfer and economic development often blur as efforts to strengthen U.S. companies have focused on maintaining and adding jobs and revenue to our domestic economy. One of the questions that our member laboratories and agencies continue to ask is, What is the proper role for technology partnerships in economic development?

▪ Conflict of Interest. Everyone wants to avoid both conflict of interest and its appearance. Yet many issues arise as federal laboratory employees transfer technology to the private sector. Within the government-owned, government-operated laboratories, the issue of conflict of interest focuses primarily on the individual researchers and laboratory managers. Within the government-owned, contractor-operated laboratories, there is the additional dimension of organizational conflict of interest (in those instances where an organization is managing the laboratory for the government and also operates as an independent company in other arenas). Comments from FLC laboratories and agencies consistently point to the need to investigate this issue further, compile best practices from across the federal community, and make a more concerted effort to learn from past experience.

▪ Filing for Foreign Patents. Federal laboratories do not always file for foreign patents, primarily because it is very expensive. Foreign patent applications can also be complicated by technical publication in the United States. The most critical aspect of this issue in 1995 for some laboratories, however, is a lack of funds. Perhaps

consideration could be given to using royalties paid back to the U.S. Treasury, or some form of self-financing mechanism, to allow for the pursuit of appropriate foreign filings. Another approach might be to allow prospective licensees to use funds allocated for the payment of domestic royalties to pay for foreign filings in exchange for future royalty considerations -- both the rate reduction and access to a broader sales base might be good business for all parties and for the U.S. economy.

▪ Exemptions from Freedom of Information Act Disclosure. The National Competitiveness Technology Transfer Act of 1989 provided an exemption of up to five years from Freedom Of Information Act (FOIA) disclosures for technical information developed under CRDAs with federal laboratories. FLC member agencies and laboratories report that the FOIA exemption is perceived by external partners as being critical to the overall success of the CRDA mechanism. We have better information about the value of the FOIA exemption from our partners than we did five years ago, but we must continue the discussion so that the information that is to be protected, and the appropriate means of protection, are understood at the earliest possible stage of negotiations. Given that the exemption appears to be valuable for our partners, the question our member laboratories and agencies ask now is, can we extend a similar FOIA exemption to other technology transfer mechanisms?

▪ What is a foreign company? Defining a United States company is important to all laboratories and agencies involved in domestic technology transfer of federally supported research and development because of the need to identify foreign companies and implement the preference for United States companies established by law. Is a wholly owned subsidiary of a foreign-based company, which is located in the United States, a foreign company? Is a foreign-based component of a United States-based, multinational organization a foreign company? One could answer each of these questions from either direction. These days we roll this item into the broader concepts of U.S. competitiveness, U.S. benefits, or agency mission benefits. If measurable benefits that will accrue to the United States are to be considered a key criterion for establishing partnerships, then we can discriminate between those activities which will occur solely within our borders and those which will take place partly or solely outside our borders.

New Language for Your Consideration

The FLC is a proven mechanism for identifying and addressing technology transfer issues across the federal community. For the past 20 years the FLC has successfully provided a viable infrastructure for the technology transfer efforts of its 16 member agencies and the 600+ research laboratories and centers they oversee. One of its greatest strengths is its grassroots network. Through the FLC, technology transfer personnel from across the federal community work with current and potential partners in industry, small business, educational institutions and state and local governments. The FLC offers training in technology transfer to personnel from government and

partner organizations several times a year, manages online systems describing federal technology transfer opportunities and activities and distributes instructional handbooks and other tools to all interested parties. The Consortium also works, through special projects, with organizations engaged in technology transfer activities ranging from professional technical societies and the national Chamber of Commerce to regional technology transfer centers.

The FLC has proven that it provides value-added services and products to its member agencies, laboratories and participating partners. We propose that language be incorporated into the Technology Transfer Improvement Act of 1995 to make the FLC permanent.

Future Language for Your Consideration

The FLC continues to support changes in legislation to permit copyrighting of software developed by federal employees and the provisions included in the legislation introduced by Congresswoman Morella in January 1990 as H.R. 523, which would enable government employees automatically to receive part of the income generated by copyrighted products, just as government-employed inventors of patentable inventions now do. These provisions would correct two inequities among developers of software: (1) one that provides for royalty income only to developers of software protected by patents and (2) the other that discriminates between developers at GOGO and GOCO laboratories by allowing royalties only to developers at GOCO laboratories. We believe that legislation such as this would provide intellectual property protection in an area where America excels, encourage commercial applications of federal employee-developed software, reward the creators of the software with a portion of the income, and help to ensure that software developed by federal employees is safeguarded for U.S. benefit.

Final Words

Thank you for the opportunity to speak with you today. We appreciate the time you have given us to share some of our lessons and observations about federal laboratory technology transfer. We would be delighted to make our materials available to the Subcommittee library or otherwise provide further information if you would like me to do so. We welcome the opportunity to work with you further.

Major Legislative Themes in Federal Technology Transfer					
Theme	Initiation	Progression			
Technology Transfer As a Mission	1980 Stevenson-Wydler Technology Innovation Act established T^2 as a mission of the federal government	1986 Federal Technology Transfer Act (FTTA) made T^2 a priority not only for GOGOs, but for every GOGO employee	1987 Executive Order 12591 emphasized the government's commitment to facilitating access to science and technology	1989 National Competitiveness Technology Transfer Act (NCTTA) established T^2 as a laboratory mission for GOCOs and GOCO employees	
Establishment of Organizations to Advance Technology Transfer	1980 Stevenson-Wydler Technology Innovation Act enabled funding for the establishment of Offices of Research and Technology Application (ORTAs) at major federal laboratories	1986 Federal Laboratory Consortium (FLC) chartered by the FTTA	1989 Conference Committee Report of the FY 1990 Independent Agencies Appropriation Act recommended the establishment of the National Technology Transfer Center (NTTC) by NASA	1991 FLC mandate extended by the American Technology Preeminence Act	1992 NASA established six Regional Technology Transfer Centers (RTTCs) under authority granted in the National Aeronautics and Space Act of 1958

U.S. Manufacture	1980 Patent and Trademark Amendments Act (Bayh-Dole) restricted exclusive rights to inventions arising under funding agreements with federal agencies to small businesses and non-profit organizations agreeing that products embodying the invention will be manufactured substantially in the U.S.	1980 Stevenson-Wydler Technology Innovation Act required that preference given to industrial T^2 partners agreeing to substantially manufacture in the U.S. any products resulting from Technology Transfer	1984 Trademark Clarification Act (amending Bayh-Dole) extended substantial manufacture in the U.S. provisions to all partners of federal agencies	1986 Federal Technology Transfer Act (FTTA) required that preference be given to CRADA partners located in the U.S. and agreeing that products embodying inventions made under the CRADA will be manufact-ured substantially in the U.S.	1989 National Competitiveness Technology Transfer Act (NCTTA) established Congressional intent that CRADAs be performed in a manner that fosters the competitiveness of U.S. industry

Small Business	1980 Patent and Trademark Amendments Act (Bayh-Dole) permitted small businesses to obtain title to inventions developed with governmental support	1982 Small Business Innovation Development Act • Established the Small Business Innovation Research (SBIR) Program • Required agencies to provide special funds for small business R&D connected to the agencies mission	1991 Defense Authorization Act established model programs for laboratories to demonstrate successful relationships between government and small business	1992 Small Business T^2 Act mandated government agency funding of cooperative R&D projects between small businesses and universities, federally funded R&D centers or non-profit research institutions	1993 FY 1993 Defense Authorization Act directed DOE to facilitate and encourage T^2 to small business

Title to Invention	Specific agency authorizing legislation	1980 Patent and Trademark Amendments Act (Bayh-Dole) permitted universities, not-for-profit organizations, and small businesses to obtain title to inventions developed with governmental support	1984 Trademark Clarification Act allowed laboratories run by universities and non-profit institutions to retain title to inventions within limitations	1986 Federal Technology Transfer Act (FTTA) allowed GOGO: • To make advance agreements with large and small businesses on title to inventions resulting from CRADAs • To grant and waive rights to laboratory inventions and intellectual property • The act also required that inventors who are government employees share in royalties from patent licenses	1988 Omnibus Trade and Competitive-ness Act extended royalty payment requirements to inventors at the laboratories who are not government employees	1989 National Competitive-ness Technology Transfer Act (NCTTA) granted essentially the same CRADA opportunities and intellectual property rights to GOCOs that had been established for GOGOs by the FTTA

Dissemination of Information/ FOIA	1966 Freedom of Information Act (FOIA): • Provided a vehicle to inform the public about federal govern-ment activities • Gave citizens the right to request agency records and have them available promptly	1980 Stevenson-Wydler Technology Innovation Act focused on dissemination of government information through an active commitment to T^2	1980 Patent and Trademark Amendments Act (Bayh-Dole) protected descriptions of inventions from public dissemination and FOIA for a reasonable amount of time to allow patent applications to be filed	1986 & 1989 Both the FTTA (1986, applying to GOGOs) and the NCTTA (1989, applying to GOCOs) allowed CRADA information to be protected from disclosure under FOIA for up to five years
Authorization of CRADAs	1986 FTTA authorized CRADAs for GOGOs	1989 NCTTA authorized CRADAs for GOCOs	1992 Energy Policy Act authorized DOE to enter into CRADAs directly, without laboratory participation	1994 Defense Authorization Act extended CRADA authority to DOE-funded Federally funded R&D Centers not owned by the government

As of August 1994

Appendix II: Questions and Answers About the Federal Laboratory Consortium

What exactly is the Federal Laboratory Consortium?

The FLC is a nationwide network of federal laboratories and their parent agencies. The FLC brings these laboratories together with potential users of federal technologies from the private sector, state and local governments, universities and other organizations.

The mission of the FLC is to speed the movement of federally-funded research and development into the United States economy. The FLC is a volunteer organization that provides laboratory and agency personnel the forum in which to exchange information and experiences. We also provide a single point of entry to the federal R&D community for potential partners and, as the first virtual federal organization, we offer a platform across the federal community for addressing complex issues associated with transferring federal technologies.

When was it established? By whom and why?

The idea for the FLC began in 1971 when several employees at the Naval Weapons Center in China Lake, California took the DOD announcement of a new Domestic Action Program very seriously. They formed a working group to look into the possibilities of using technologies and expertise developed within the Naval Weapons Center to improve medical technologies. In 1971 the Center established a Technology Utilization Office. This was the cornerstone for the creation of the FLC. During 1971, this Office developed projects in telecommunications, law enforcement, biomedicine and air quality control. Each project had as a partner the federal agency with oversight responsibility for the technical area and one or more state or local organization interested in finding out what the Naval Weapons Center (and a growing number of other DOD labs) to offer. By the end of that year, the DOD Laboratory Consortium had been created. In 1974, at the urging of NASA, EPA, the Atomic Energy Commission and other federal agencies, the DOD Laboratory Consortium was broadened to become the Federal Laboratory Consortium.

Who participates in the Consortium today?

Today more than 600 federal laboratories, agencies and research centers are members of the FLC. R&D work takes place at these facilities for 16 different federal agencies. This includes all federal agencies that have research and development as part of their mission.

All of the major federal agencies (Agriculture, Commerce, Defense, Energy, Health and Human Services, Justice, Transportation, and Veterans Affairs) which have an R&D component in their missions (although not all of these agencies have government-owned, government-operated laboratories or federally funded research and development centers). In addition, FLC member agencies include the National Science Foundation, NASA, the Central Intelligence Agency, the Environmental Protection Agency, and the Tennessee Valley Authority.

Virtually all of the laboratories that have at least ten staff belong to and are represented in the FLC. One out of every five scientists or engineers engaged in R&D in the United States works at these laboratories.

What do all these diverse labs and agencies have in common in the area of technology transfer?

First of all, all federal entities operate according to legislation passed by Congress. Fifteen years ago, the Stevenson-Wydler Technology Innovation Act established the Office of Research and Technology Applications that I mentioned earlier....in all laboratories that have more than 200

personnel or a budget greater than $20 million. Then, in 1986, the Federal Technology Transfer Act, which also officially chartered the FLC, gave federal laboratories the authority to enter into cooperative research and development agreements with outside partners. There have been other laws and an occasional executive order as well to complete the framework for federal technology transfer today. All of our member laboratories and agencies operate under this framework.

What do these diverse organizations do differently in technology transfer?

Each federal agency has a different mission; for each mission, some ways of transferring technologies are better than for others.

The agencies can be quite different with respect to things such as assigning rights to intellectual property, selecting priorities for their technology portfolios, and determining the most appropriate partners for the technologies they develop. There are also differences between government-owned, government-operated laboratories and federally funded research and development centers. Finally, there are differences that are based on the nature of the research and development that the agency supports and the laboratories perform. One might transfer ideas and expertise from a laboratory that performs bench type research one way and then select a very different mechanism to transfer a technology that has already been tested in prototype and needs to only be commercialized.

Does the Consortium actually transfer technologies?

No. Our member laboratories and agencies transfer technologies.

How does the FLC organize technical topics covered in federal research and development?

We manage something we call our Laboratory Locator Network. If you call in and say that you would like to know which federal laboratories are currently working on environmental pollution technologies, for example, we go to a taxonomy of technical specialty areas that we have used for over a decade that slices and dices the technical programs underway in our member laboratories and agencies. We would give you the names and numbers of technology transfer personnel in the laboratories that have told us they are working on environmental pollution technologies and ask you to call us back if you have any problems getting their attention.

The laboratory contacts that we give you are also our FLC representative so they expect to get these calls. Because they know their laboratories best, they will be able to tell you who the technical experts are within their facility and if they are available to answer your questions. They will also be able to tell you whether the laboratory has any patents in place, or pending, on the technologies you are interested in.

What are typical FLC activities? Who participates?

The 1986 Federal Technology Transfer Act that officially chartered the FLC says that we will develop and deliver training to increase the awareness of federal personnel about technology transfer, advise and assist our member agencies and laboratories on their technology transfer programs, provide a clearinghouse for requests, strengthen communication across the federal technology transfer community, incorporate the experiences of our member agencies into our practices and work with state, local, regional, university, business and similar organizations to further the transfer of federal technologies.

So what does all that mean? It means we develop and deliver at least four training sessions a year (sometimes more), write and distribute training handbooks to technology transfer personnel in the federal community and outside it, hold semiannual meetings to which our member labs,

agencies, potential partners, broker organizations and others are routinely invited, write and issue special reports that focus on key areas of interest, give lots of presentations to professional technical societies and the like and work on federal system wide efforts in technology transfer, such as supporting the NASA Technology 2004 annual exhibition.

Who participates? Anyone who is interested. We have User Committees for Small Business, Industry, Educational Institutions and State and Local Government; members of these groups serve on the committees and help to make projects happen. We also have a National Advisory Group with representatives from small business and industry, state governments and universities and other organizations who offer suggestions for new projects and help us ensure that what we take on will prove helpful to users of federal technologies and expertise.

The FLC agency liaison group includes more than 30 senior technology transfer and technical program representatives from 16 different federal agencies.

Within each of the six FLC regions we have a Regional and Deputy Regional Coordinator responsible for working with the labs and potential partners in their regions.

The FLC is essentially a nationwide network that thrives on diversity. It is in our best interest to work with all of the organizations that interact with the federal research and development community and the companies, municipalities and others who want to know what that community has that can be helpful to them.

Historically, are these activities different from the ones that FLC members were involved in 20 years ago when the Consortium was founded? How are they different?

They are different in two major ways. First, there are lots more activities of all kinds and second, 20 years ago federal laboratories and agencies were essentially forbidden to work with companies of any kind. Today, businesses are our most sought after partners but 20 years ago we could not even consider the possibility of working with a private organization. We had legislative and policy restrictions that have been lifted just during the past decade. This is the single biggest change between the early days and now.

How do technology transfer people in the labs and agencies actually transfer technologies? What types of mechanisms do they choose? Do these mechanisms differ from place to place? Does the FLC play a role in the selection of these mechanisms?

There are more ways to transfer technologies than there ever have been before. The mechanisms include some that have been in place for a long time, such as delivering a paper at a technical conference, and others that are fairly new, such as working with a major industrial sector to identify where there are shared technology needs that match agency and laboratory missions. This last item is what is often referred to as a roadmap: where are there shared needs for technological improvements in ceramics, for example? How can we plan federally funded research and development so that the federal mission is met and private partners can gain as well?

Yes, mechanisms do differ from place to place to some extent. And their selection is based on many reasons. The most important reason for selecting a particular mechanism is because it best fits the technology, the needs of the laboratory and the needs of the partner. But, as you would expect, all of these things can vary with every circumstance.

The FLC does not play a role in the decision of any particular laboratory or agency to select one mechanism over another. We do believe we have a responsibility to provide our laboratory and agency representatives with training tools and lessons learned associated with using the mechanisms available. We also believe that we can provide a service in terms of explaining to potential partners how federal laboratories and agencies are likely to respond to their inquiries.

APPENDIX III: 1995 FLC AWARDS FOR EXCELLENCE IN TECHNOLOGY TRANSFER

DEPARTMENT OF AGRICULTURE

Agricultural Research Service
Cereal Product Utilization Research
Thomas F. Schatzki
For developing and promoting the use of x-ray imaging as a tool for detecting agricultural contraband and contributing significantly to the protection of U.S. agriculture.

Agricultural Research Service
Subtropical Horticulture Research Station
Jennifer L. Sharp
For management, research, development and effective technology transfer of a hot water quarantine treatment, resulting in significant international agricultural impact.

Agricultural Research Service
Boll Weevil Research Unit
Gerald H. McKibben
For the design and development of attract-and-kill technology, and outstanding achievement in transferring this new control technology to industry.

Agricultural Research Service
Plant Sciences Institute
Aref A. Abdul-Baki
For outstanding effectiveness in transferring technology to farmers for production of vegetables with a reduced-input system developed through his research.

Agricultural Research Service
Plant Sciences Institute
Jeffrey R. Aldrich
For the successful transfer of the patented discovery of "Synthetic pheromones for the spined soldier bug, podisus maculiventris."

Agricultural Research Service
Insect Biocontrol Laboratory
Martin Shapiro, Edward M. Dougherty, John J. Hamm
For the transfer of technology in development of the first commercial enhancer for viral biopesticides.

Forest Service
Forest Products Laboratory
Theodore L. Laufenberg, John F. Hunt, C. Tim Scott, Roland Gleisner, Janet I. Stockhausen, John Bachhuber, Debra J. Dietzman
For the successful transfer of Forest Products Laboratory's Spaceboard technology to private industry to manufacture a family of structural fiber products made from recovered paper materials.

Forest Service
Northeastern Area State and Private Forestry
Daniel B. Twardus, Stephen C. Smith
For the development of the Calibrator, a portable expert system that helps to quickly and accurately calibrate aircraft spray systems.

DEPARTMENT OF COMMERCE

National Telecommunications & Information Administration
Institute for Telecommunication Sciences
David R. Wortendyke
For the development, proof-of-concept evaluation, implementation and distribution of audio compact discs containing ALE tones representing the HF ALE radio Federal standards.

National Oceanic and Atmospheric Administration
NW Fisheries Science Center-Kodiak Laboratory
Jerry K. Babbitt, Kermit D. Reppond
For the development of a process technology for generating value added products from fish offal.

DEPARTMENT OF DEFENSE

Air Force Armstrong Laboratory
Bruce J. Nielsen
For successful transition of laser optic spectroscopic in situ contaminant identification technology for commercialization as the Rapid Optical Screening Tool (ROST).

Air Force Armstrong Laboratory
James W. Parlett, Terresa Jackson, J. Wesley Regian, Jr., Stephen J. Toth, Kurt W. Steuck, Alicia D. Cruz
For excellence in public service and technology transfer through commercialization of the Fundamental Skills Training Word Problem Solving tutor for at-risk public school students.

Air Force Rome Laboratory
Douglas G. Smith, John J. Grieco, John G. Parker, Jr., Laurie H. Fenstermacher, Bridget E. Withers, Edward J. Cupples, Sharon M. Walter, Stephen E. Smith
For the development of speech enhancement technology to improve voice communications for military and commercial applications.

Air Force Rome Laboratory
Lee Uvanni
For the advanced, robust neural network technique able to detect malignant lung tumors.

Air Force Rome Laboratory
Richard Linderman, Ralph Kohler
For developing a multi-chip stacking technology to increase memory densification while shrinking the physical volume of computer memory by factors of hundreds over conventional memory approaches.

Army Command Control and Systems Integration Directorate
Carl R. Elks
For a new cooperative research agreement between Union Switch & Signal, NASA LaRC and the Army Joint Research Programs Office that will allow safety-critical design methods, originally intended for the U.S. aerospace industry, to be transferred and utilized in the design of safety-critical railway systems.

Army Edgewood RD&E Center
Peter J. Stopa
For his outstanding contributions in transferring critical diagnostic kit technologies to the Disease Control communities of the United States and three allied countries.

Army Missile Command RD&E Center
Robert W. Milton, David W. Dawkins, Leeoma Whitman, Robert L. Stanley, L.B. Thorn, W.D. Stephens
For outstanding achievement in the transfer of fullerene processes and coating materials that reduce radar clutter and interference affecting navigation and general public safety.

Naval Surface Warfare Center-Carderock Division
Nathaniel H. Gorin, Gerald Shay, Charles J. Fleck
For outstanding achievement in conceiving, designing and building shipboard oil/fuel analysis equipment which has revolutionized the way the Navy tests the key properties of these fluids.

DEPARTMENT OF ENERGY

Argonne National Laboratory
U. Balachandran, J.T. Dusek, P.S. Malya, R.L. Mieville
For transferring technology to industry to upgrade natural gas into vital pollution-reducing fuel additives, liquid fuels and other chemicals.

Idaho National Engineering Laboratory
David H. Meikrantz
For transferring the Annual Centrifugal Contactor (oil-water separator) technology.

Lawrence Livermore National Laboratory
Thomas E. McEwan
For the development of a new category in sensor technology and its licensing to high technology companies.

National Renewable Energy Laboratory
David Ginley, Carol Ashby, Douglas L. Schulz, Tom Plut, Jeff Alleman
For developing and transferring the technology of chemical processing systems that can precisely etch circuits in thin films of ferroelectric and high-temperature superconducting materials.

Oak Ridge National Laboratory
Timothy C. Scott
For the invention, development, technology transfer and technical follow-up which led to industrial implementation of the Emission Phase Contactor.

Oak Ridge National Laboratory
Tuan Vo-Dinh, Wayne Scarbrough, R. Russ Miller, Lou Lome, M.G. Yalcintas
For the development and transfer of SERODS High-Density Optical Data Storage.

Pacific Northwest Laboratory
Morris S. Good
For development and transfer of the Ultrasonic Microstructural Analyzer (UMA).

Pacific Northwest Laboratory
Steven D. Miller
For developing a unique business association that allowed him to transfer his COSL technology into the marketplace.

Pacific Northwest Laboratory
Larry W. Brackenbush, Gordon A. Anderson
For redesigning an expensive defense-oriented technology into "Scout," a practical and economically attractive field instrument, and making it commercially viable for a small manufacturer.

Pittsburgh Energy Technology Center
Scott M. Smouse
For outstanding efforts in promoting technology transfer, both nationally and internationally, for the PETC Combustion and Environmental Research Facility (CERF).

Sandia National Laboratories
Eric Snyder, William Filter, Ed Cole, Chris Henderson, Jim Sweet
For a cooperative transfer of an advanced suite of techniques for improving the quality and reliability of microelectronics to a broad base of U.S. integrated circuit manufacturers.

Appendix IV: Some Publications Available from the FLC

Training Handbook Series

Vol. I - FLC Representative's Handbook - Provides facts and background needed to serve as an active participant in the FLC national network.

Vol. II - ORTA Handbook - Explains, in general terms, the technology transfer roles of personnel working in federal laboratory technology transfer offices.

Vol. III - Tapping Federal Technology - Identifies 156 sources of federal information and assistance available from agencies.

Vol. IV - CRADA Handbook - Designed to help the reader understand the fundamentals of Cooperative R&D Agreements (CRADAs), this handbook includes common language and sample CRADAs from several agencies.

Vol. V - Patent & Licensing Handbook - Directed toward an understanding of utility patents and their licensing.

Special Reports

Technology Innovation - Chapter 63, United States Code Annotated Title 15, Commerce & Trade, Sections 3701-3715 (as amended through 1993 public laws and with annotations).

FLC History - An account of the transition of the FLC from a small organization of 12 laboratories to a nationally recognized body of more than 600 laboratories and centers.

Technology Transfer in a Time of Transition - A resource guide for professionals who practice technology transfer.

Linking Federal Laboratories with Small- and Medium- Sized Enterprises - A manual intended to provide guidance to organizations that assist private industry.

Winners in Technology Transfer - A collection of stories about past winners of the FLC Excellence in Technology Transfer awards. The book features selected recipients and their successes in technology transfer.

Mrs. MORELLA. Thanks, Ms. McKinley.
Dr. Templin?

STATEMENT OF DR. ROBERT TEMPLIN, JR., PRESIDENT, VIRGINIA'S CENTER FOR INNOVATIVE TECHNOLOGY

Dr. TEMPLIN. Madam Chairwoman, thank you very much for having me here today. I'm from that other state across the Potomac, Virginia, representing Virginia's Center for Innovative Technology, and I think illustrative of what's happening in the states across the nation.

And that is that increasingly states are devoting resources to accelerating economic development through the creation and retention of technology-based companies.

And as they look at their states' resources, they naturally see universities and other knowledge producers within the state. But increasingly, also, looking at federal labs within their states' borders as assets that could be positioned with industry in a state strategy to provide economic development for the welfare of that state.

CIT is a third party organization in technology transfer that coordinates the resources of Virginia's colleges and universities over the past 10 years. During that period of time, we've co-funded almost 850 collaborative research projects, and we currently have over 300 licenses available from the inventions that have been discovered from that process.

Increasingly, we're looking to our federal labs to be partners with our universities and with other state resources to develop technology, and to commercialize that. In the process, we've found in recent years that the labs have been increasingly responsive to our request to be collaborators in a partnership. But there are still several factors that I would ask your attention to.

Number one, we experience our best success when what we are responding to is market-driven rather than laboratory-driven.

Secondly, we find our best success in a complex partnership when the laboratories are delegated the authority to negotiate agreements at the lab level.

Third, the incentives that we need to create within the laboratories go beyond incentives for commercialization of technology under CRADAs. Increasingly, the laboratories have personnel and facilities that are unique, often to a region or to an industry, that are needed for technical assistance of a short term nature.

The incentives that are needed are to create a climate within the laboratory where it is understood that a part of the job expectations of the scientists and the engineers and the technicians is to collaborate in technical assistance.

I don't know of an environment where we have job expectations written into job descriptions or evaluations, stating that expectation. As a consequence, often the response to the request received is dependent upon the personally of the individual that's requested within the lab.

In other words, we have a broad framework within which cooperation can take place, but no uniform expectation with regard to responding to those requests.

So I see these assets increasingly being those that the states wish to position and take strategic advantage of in states' economic development strategies. Increasingly, our partnerships are complex and need to be responsive and timely.

With your amendments, and with additional incentives, I believe that we can forge an effective partnership.

Thank you.

Mrs. MORELLA. Thanks, Dr. Templin.

Mr. Preston, from Massachusetts.

STATEMENT OF JOHN T. PRESTON, DIRECTOR, TECHNOLOGY DEVELOPMENT ASSOCIATION OF UNIVERSITY TECHNOLOGY MANAGERS

Mr. PRESTON. The direct answer to your question is yes. The laws as we've passed them are working well, and we've seen an enormous improvement over the last 10 years. And I support, by the way, your new proposed legislation as accelerating that trend.

However we still do have a problem. We see factors of 100 difference in the effectiveness of technology commercialization if measured in job and wealth and international competitiveness for U.S. companies.

We see huge differences between different research organizations. And I'm reminded of a quote by Professor Lester Thurow he gave at a dinner talk recently with me, where he said that he was looking at China.

He said all of the technologies that were necessary for the Industrial Revolution existed in China 600 to 800 years before they existed in Europe. Yet the Industrial Revolution occurred in Europe, not in China. Why is that?

He looked at it, and the reason is the attitudes of the people were different.

Now, at MIT, we see huge entrepreneurial activity. At other universities—and we're actually analyzing this. We're doing a research project looking at, what are the attitudes that create that environment to stimulate spinoffs from federally funded research?

And we're comparing one other university that does great research, but doesn't have any of that entrepreneurial spinoff.

We see the federal labs lagging the U.S. universities in terms of the effectiveness of tech transfer, but catching up, and catching up to a large degree because of some of the legislation that was passed 10 years ago.

I wanted to just amplify on Mr. Schiff's comments that I think that the government must participate in this activity. Now, I'm an entrepreneur. I love the private sector. But I know there are things that the private sector is going to refuse to do, and especially because they're driven by the stock market to generate short-term results.

They're going to refuse to do the longer-term investments that are being supported by the tech transfer from federal labs.

So I think it's not a question of, should we do it—we must do it, because our international competitors are doing it. The proof of that is that, if you look at the balance of trade of technology between the U.S. and our foreign competitors, you find that we're an imbalance.

We export more technology that creates billion-dollar-plus businesses than we import, particularly in the physical science area, where everyone knows the examples. VCRs, invented in the U.S., commercialized in Japan; CD players, liquid crystal displays, hard disk drives to Singapore. And the list goes on and on and on.

Interestingly, though, we find that the attitudes and in part the federal regulations on the life science side support a much more robust domestic technology transfer. And we find that on the life science—do we have to interrupt, or are you being called for a vote?

Mrs. MORELLA. We're being called for a vote. But we have 15 minutes. So this committee usually allows ourselves 10 minutes, then we dash off to vote, and we'll come back.

Mr. PRESTON. I was going to make the point, on the life science side, we see much more effective domestic tech transfer and about 90 percent of the royalty income received by U.S. government labs is in the life science field. And the NIH has shown higher success rate than some of the sister organizations.

If you look behind that, you find it is indeed federal policy and regulations that are speeding that tech transfer.

I'll stop with those comments. Thank you.

[The prepared statement and attachments of Mr. Preston follows:]

THE ROLE OF THE FEDERAL GOVERNMENT IN TECHNOLOGY COMMERCIALIZATION PRESENTED AS TESTIMONY BEFORE THE SUBCOMMITTEE ON TECHNOLOGY OF THE U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON SCIENCE

John T. Preston
June 27, 1995

I truly appreciate being given the opportunity to address you today.

I must start by applauding this congressional effort to address the critical needs in this country regarding the commercialization of technology and the proper role of the Federal government. The future of this country is closely tied to the utilization of science and technology. In his speeches, Dr. Bruce Merrifield, former Assistant Secretary of Commerce, continuously reminds us that 90% of the scientists and engineers that have ever lived are alive today. The implications of this fact are astonishing. Our knowledge of technology is increasing at an incredible rate, yet our ability to utilize technological innovations for public good and international competitiveness has not kept pace with several foreign competitors. **Often, the net effect of our slowness to commercialize technology is that U.S. ideas and inventions are better adopted by foreign competitors than by U.S. companies.**

U.S. Industry has, over the past ten years, been pushed by the capital markets toward short term results. This emphasis on the short term has reduced funds available for commercializing innovative ideas in medium to long term projects. In effect, the U.S. financial system rewards short term performance at the expense of long term performance. That system is, in part, a product of Federal policy and often leads U.S. companies to eat their seed corn for short term benefit while losing long term competitiveness. To focus this paper, I will avoid a detailed discussion of federal financial policies and their impact on technology development, except to note that it is a topic of equal importance to the subject matter being addressed today. Attached to this testimony are several papers which address this subject in greater detail.

Industrial shift toward shorter term performance has meant that U.S. Industrial labs that once led the world in creating new technology have been slowly reduced over the past ten years to the point where they are no longer technological leaders. One need only look at our industrial labs in telecommunications and computers to see this trend.

A key finding in Representative Morella's proposed legislation is that "the federal government can help U.S. business to speed the development of new products and processes..." It is my view that the federal government **must** help U.S. businesses commercialize technology or this country will continue its drift away from being the world's strongest economy.

Over the past five years, I have been examining a flaw in America's ability to commercialize innovative ideas - a problem I refer to as the "funding gap" (see *1993 Testimony*). This gap is highly industry dependent with the physical science industries (autos, utilities, electronics) showing greater gaps than the life science industries (pharmaceuticals and biotech). Many people have argued that there is no problem and that the private sector will take care of the gap in funding between the generation and adoption of technology. They argue that investments will be attracted to good ideas while the bad ones will not be funded. This argument is wrong! We do indeed have a gap and our foreign competitors are filling it for us. The proof of the existence of a gap relative to foreign competitors is the fact that the U.S. is a net exporter of

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technology in most physical science industries, while, interestingly our performance in the life science side seems relatively balanced or potentially a net importer for the U.S. The overall effect is that we enjoy a robust pharmaceutical industry and totally dominate biotechnology worldwide, while we are slowly seeing the erosion of consumer electronics, automobiles, power electronics, etc.

The difference between various industries' ability to adopt innovative technologies for international competitive advantage is Federal Government policy and practice! For example, the value of intellectual property in the life science industries is greatly enhanced by federal regulatory approvals which require second entrants to utilize exact protocols and compositions for the manufacture of pharmaceuticals. In addition, federal financial support covers a broader spectrum in the life science fields as the government is willing to support not just basic research, but also human clinical trials and even the treatment of patients who are unable to afford medicine. The support for other industries is much lower. Physical science industries are less able to count on patents because a second company entering the business can more frequently design around the first patent. Furthermore, federal support for the middle and later stages of technology commercialization is less substantial. Can you imagine the government buying cars for people who cannot afford a car? The difference is that the interests of the federal initiative in medicine are closely aligned with increased competitiveness of U.S. industry and its ability to improve the quality of life for Americans. The alignment of government/industry interests in the physical science fields is much weaker. In these fields the government interests have been directed toward military excellence and U.S. industry has benefited only by the extent to which it is able to utilize military research results and its ability to make dual use products, (e.g., computers, software...). Interestingly, when the government and industry's interests are more closely aligned we see stronger industrial performance - even in the physical science fields. For example, ARPA funding can be tied to nearly every major advance in the computer industry. This synergy between government and industry seems to have greatly contributed to U.S. dominance in the computer industry.

Let me provide some supporting data and anecdotes to the conclusion that we are failing relative to our foreign competitors in commercializing physical science inventions while excelling in the life sciences. During the decade from 1981 to 1991, inventions made by the National Institutes of Health accounted for 90% of the royalty income received by the U.S. government according to a GAO study. This occurred despite the fact that NIH accounted for a small fraction of government funding, much smaller than funding in the physical science fields - DoD, NASA, DOE, DOT, DOC,... A similar pattern emerges in examining university licensing. The majority of the successes come from the life science field despite the higher funding in the physical sciences. I have been unable to find a single significant example of a U.S. invention in the life science field that has been exported to foreign competitors. However, I have found an example where Japanese pharmaceutical technology was imported into the U.S. to help found Marion Laboratories (which is now a billion dollar plus U.S. pharmaceutical company). By contrast, the physical science area is filled with examples of U.S. technology exports, but few examples of imports. The exports of U.S. inventions that now represent multibillion dollar businesses for our foreign competitors include liquid crystal displays, VCRs and, CDs to Japan and hard disk drives to Singapore.

Current technology transfer practices in U.S. laboratories and universities are suboptimal at carrying out the mission of strengthening U.S. competitiveness. While there is no question that significant progress has been made over the last decade with many labs enjoying a ten-fold increase in licenses and industrial interactions, overall our performance needs much improvement. There are several factors that lead to such a conclusion. Within Federal Labs there is considerable peer pressure against technology commercialization. For example, federal employees who take advantage of consulting privileges with industry are viewed as having "sold out," and their lives within the lab are made more problematic. Talking about negative peer pressure risks making circumstances difficult for these employees.

Similar pressure still exists in universities. Recently, Prof. Lester Thurow, of the Massachusetts Institute of Technology, gave a talk in which he stated that all the technologies needed for the industrial revolution existed in China 600-800 years before they existed in Europe. Yet the industrial revolution occurred in Europe. In analyzing why the Chinese failed to lead the industrial revolution, Thurow concludes that the attitudes of the people in Europe were more conducive to technology development. We are studying the differences in new business formation out of research universities and find that the attitudes at MIT have led to rapid business formation, while the attitudes at other schools with equally high quality research have led to virtually no new business creation.

In addition to negative peer pressure, there are many other problems with government technology transfer programs. CRADAs often suffer from the wrong metric in measuring performance - the dollar amount of the CRADA, not job and wealth creation. Worse yet, several companies have taken legal action claiming that a CRADA unfairly helps a competitor. This has led the government to seek CRADAs with industrial consortia. Our experience indicates that this is one of the worst possible courses of action. Consortia of companies are much less able to take the quick action needed to commercialize a technology than a single company. In addition, having multiple companies eliminates the competitive advantage that would accrue to a single company, thus lowering the incentives and the passionate behavior needed to succeed.

The ATP program has alienated universities by not allowing them to take title to their own inventions. Thus one of the best sources of creative minds is not interested in participating in ATP programs. Some licensing offices both within universities and the government have failed to properly understand the business conditions related to developing their inventions. This may alienate companies that otherwise might develop the technology. Conflict of interest policies within federal labs and public universities often tie their people in knots and, as in the CRADA example above, lead to suboptimal strategies to commercialize technology. The list of problems goes on and on.

I find that the best practices in the private sector for technology development are much more effective than those of the government. This is not an argument to privatize such development because, as mentioned above, the private sector will be unwilling to take on the types of long term projects I think are the essential responsibility of the government. However, we can learn how to improve the government systems by applying some of the lessons from the private sector.

In the paper *National Strategies for Technology Commercialization*, Prof. David Staelin and I argue that venture capital firms apply funds more effectively to create U.S. jobs and wealth than do government technology development programs. This leads to an argument for greater competition between government technology funding sources to make them emulate the venture capital industry. Such an approach would create competition for the technology funding monopolies within each branch of the government.

Within the federal labs we need to apply similar competitive practices. For example, I co-founded the fastest growing public environmental company in this country. When that company funds technology development, they do so somewhat differently from federal labs. They first define the mission with laser-like precision and then break the mission into tasks. Next they look for the best people anywhere in the world to achieve those tasks. This mission-oriented behavior is similar to the way federal labs behaved during World War II. The Manhattan Project is a good example. In the case of the small five year old environmental company, they are collaborating with sources of technology in the U.S. as well as abroad. This company has collaborative projects with many of the national labs and has taken advantage of the national pool of expertise created by the federal labs. The net effect is that they are able to develop technology faster than their foreign competitors, and have created U.S. dominance in an important emerging field. Note that the CEO

of this company is being judged by the company's ability to apply technology for competitive advantage. By contrast, I suspect that the performance of most federal lab directors is based on funds brought into the lab and on fulfillment of military missions which have become more blurred by the end of the cold war. Some of the missions of these labs are moving toward commercial development, yet the management practices lack the flexibility and reward structure of entrepreneurial companies.

Vanevar Bush set forth the structure of research in this country with the basic premise that research will lead to discovery which will in turn lead to industrial strength. I believe that we must move beyond that excellent starting point to add several additional factors. Specifically, the role of federal funding should include;

- basic research, as outlined by Bush. Such research has and will continue to lead to discovery which generates huge benefits to America.

- a national capability, by the creation of technical expertise that can be utilized by industry. This technical expertise must be broader than the interests of the military and should include excellence in industrially important fields. This capability must include research for graduate students, since, like medicine, technology must be learned hands-on. Can you imagine learning brain surgery without ever working with a skilled surgeon? Technology can only be fully taught by engaging the students in research or development.

- applied, mission-oriented research targeted toward a specific goal. Such projects should be ones that industry would normally avoid as being too expensive or too long term. The metric for success in our laboratories must relate to the end goal (e.g., in medicine, curing cancer - or in computers, recognizing human speech).

- programs to effectively facilitate technology transfer. We need to make sure that U.S. companies have ready access to federal technology.

There is a critical need for creative new approaches to technology commercialization. We need to have the courage to lower the bureaucracy that stifles entrepreneurship. We must manage federal technology programs the same way a small company would manage a project, by finding the best people for the task, motivating them to accomplish the task, and clearing the red tape. Changing cultures is extremely difficult and requires support at the highest level. Perhaps, for example, the President's cabinet should include a post devoted to stimulating technological advantage for U.S. industry. If we fail to improve our ability to commercialize technology, I worry that the next industrial revolution will occur in Asia and our descendants will say that we had all the technology necessary, but did not have the right attitude.

KEY PROBLEMS IN COMMERCIALIZING TECHNOLOGY IN THE U.S.
PRESENTED AS TESTIMONY BEFORE THE ENERGY SUBCOMMITTEE OF THE
HOUSE SPACE SCIENCE AND TECHNOLOGY COMMITTEE

March 23, 1993

Thank you for the opportunity to address you today. I am John Preston, Director of Technology Development for MIT and MIT's Lincoln Laboratory (run by MIT for the Department of Defense). I have spent my adult life commercializing technology. I am convinced that this is the best way to improve the American standard of living and to improve our international competitiveness.

As an entrepreneur, I have founded, (or assisted in founding), five companies which have a market value of approximately $.5 billion, two of which are publicly traded. In addition, I head MIT's technology transfer efforts. In the latter capacity at MIT my office and I have helped to create more than 60 companies over the last nine years (Table 1). These companies are worth more than $2 billion, employ more than 2,000 Americans, and are growing rapidly. Thirteen of these companies are now publicly traded.

In addition MIT's Technology Licensing Office negotiates approximately 80 significant licenses each year. My best guess is that this represents more than 20% of all the U.S. university licenses to industry. Last year we filed 180 patents on 450 invention disclosures (two inventions a working day). Fifty-eight percent of MIT patents are licensed to industry within one year of the patent being granted to MIT. About 85% of our licenses go to U.S. owned companies and 100% require significant manufacture in the United States.

KEY PROBLEMS IN COMMERCIALIZING TECHNOLOGY IN THE US

1. Funding Gap

There is a funding gap for technology in the United States. This seems bizarre in a country that spends as much on research as Japan, Germany, France and the UK combined. The U.S. government funds most of this country's early technology development, whereas industry funds the later stages of scaling up the technology into full production. The problem is that there is a lack of funding for demonstrating technologies at small production levels or building the first pilot plant.

The most critical point in technology commercialization is before investors are willing to make risky investments and after government research funding sources consider the project too commercial to fund. Figure 1 shows this gap as the trough in the combined industry and government curve. Much of our technology has languished in this gap, only to be recognized by foreign competitors and developed abroad. U.S. research (in both university and government labs) often generates potential commercial spinoffs that are too embryonic to be adopted by U.S. industry for a variety of reasons:

- the research is generally not directed toward commercial activities, but rather is a spinoff of military missions;
- U.S. companies are generally unwilling to invest in long-term projects for reasons that will be discussed below;
- researchers in academe and government labs often dislike more applied research; and
- there are few sources of funding in this intermediate stage of development.

Small companies and startups have too often been the only ones to jump into this gap with money that they are willing to risk. And make no mistake, this is the riskiest stage of funding in a technology

cycle; hence the names "risk" or "venture" capital. "Venture capital" is shortened from its original name, "adventure capital."

One could ask the question: What benefit would occur if the government funded more of the technology development stages? There are some pertinent examples of the U.S. government funding the gap for specific industries.

The government funds medical research across the spectrum of technology development, from basic R&D to human clinical trials to supporting health care for the needy. In addition, firms in young industries also tend to invest over a broader spectrum, further reducing the gap (Figure 2). In the late 1950s the government funded jet aircraft across the spectrum from R&D production. Unlike today's airplanes, these aircraft were nearly identical to the 707s that Boeing produced for commercial applications.

The United States developed worldwide dominance in aircraft in the 1950s that has lasted up to today, just as the U.S. medical products industry is second to none. In most other industries, the government does not fund beyond the R&D level (e.g., consumer electronics, autos, steelmaking, etc.). It seems clear that when the government teams up with academia and industry, and participates throughout the spectrum of technology, the United States becomes dominant in that industry. However, when we fail to fund the gap other countries, such as Japan, will. This often leads to foreign companies successfully commercializing ideas pioneered in this country.

Why MIT has been so successful at technology transfer.

MIT, unlike many universities in this country, was founded on the basis of combining academic studies and applying technology to manufacturing. Since its creation, MIT has embraced interactions with industry and conducted research with potentially practical applications. Thus the spectrum of research is shifted closer to the gap than other universities, (Figure 3). The results in terms of new business creation have been staggering. A study done by the Bank of Boston identifies 636 MIT alumni-founded companies in Massachusetts alone, with revenues in 1988 of approximately $40 billion. Another study identifies 225 MIT spinoff companies in Northern California, with 1989 revenues of $22.5 billion. In addition to creating new companies, MIT has extensive interactions with existing companies, including collaborative research and faculty-consulting relationships.

Spinoff companies are not a new phenomenon. The Bank of Boston study shows that MIT spinoff companies started as early as the 1880s (only 20 years after MIT was founded) with the companies Stone and Webster, Charles T. Main, and Arthur D. Little, which are still thriving today. This trend continued through the 1920s with Raytheon, the 1940s with E.G.&G., the 1950s with Digital Equipment, and it is currently spinning off businesses faster than at any time in its history.

The level of new job creation shown by the MIT spinoff data indicates the importance of encouraging the interaction between industry and our nation's research labs, whether at a university or a government lab. The usefulness to American society of any research is proportional to the interactions between the generators of the technology (e.g., university researchers) and the adopters of that technology (e.g., industry).

How Pacific Rim countries invest in technology commercialization.

I have examined the technology spending of the governments of some of our most aggressive foreign competitors. What we find is a shift in funding to fill the gap (Figure 4). In strategic industries, our foreign competitors can acquire the research results nearly free of charge from the U.S. and U.K. and other countries which fail to fill the gap. We enable the acquisition of research results through our culture of openness - publishing research results and failing to aggressively patent. When we do patent, we often find that foreign competitors are more eager to license the technology than their U.S. counterparts.

Exclusive foreign licensing without the requirement to manufacture in the U. S. transfers the value of the technology abroad. As mentioned above, MIT has found ways to succeed in the U.S. We believe that these lessons could be applied to the National Labs.

National Labs have the skills to fill the gap.

The U. S. National Labs have the expertise to apply scientific discoveries to build first prototypes of a product. These are exactly the skills that are needed to fill the gap (Figure 5). During the cold war these skills were applied to prototyping military products and even limited production of military products. Now, we face the challenge of applying some of these skills to U.S. industry.

2. American Industry is too Focused on Short Term Performance

Willingness to fund the risky stages of development (the "gap") is tied more to the ownership of the company than it is to the size of the company. Large companies with significant blocks of shares held by the top management are often willing to invest in developing high-risk technology. A recent study by D. Mark Cunningham of Buck Consultants shows that the stocks of publicly traded companies with "manager-owners" have outperformed the Standard & Poor's 500 tenfold in the last 20 years (Figure 6). These companies are like small companies in that the key decision makers care about the long-term success of the company and not the next quarter's results.

For example, Motorola has one family that owns more than 10% of its shares; that family is actively involved in managing the company. This ownership enables Motorola to more aggressively invest in high-risk, high-payoff technologies, because the family wants to pass the shares on to the next generation and is more interested in optimizing the long-term than the short-term performance.

By way of contrast, General Motors is owned by pension funds and speculators in the stock market. None of these owners thinks of himself/herself as the owner of GM, and all of these owners would sell their shares tomorrow if they thought the shares were going down in value. Companies owned in this way are driven to optimize short-term behavior, which accentuates the funding gap problem.

It is interesting to note that large Japanese companies are owned by banks, not pension funds. The banks have a different orientation than pension funds. They want to maximize the long-term health of the company to be able to maintain their banking relationship. Thus they are much more willing to support wealth-creating investments than short term (wealth-shifting) behavior. In addition, the longer job tenure in Japan and Germany encourages a long-term focus.

Owners who are interested in the long term invest to create wealth, while stock speculators invest to shift wealth. Creating wealth is good for our economy because it creates jobs and international competitiveness, whereas shifting wealth is a drain on our society because it takes funds away from more productive uses. Figure 7 demonstrates this point by showing how sacrificing short-term profitability generates long-term gains. The curve marked "B" is the long-term investor in technology or capital equipment. It shows greater near-term investment to create greater long-term benefits. In the short-term this investment strategy makes less profit than the "A" curve, but the long-term is much more successful.

Managers who are driven by near-term stock market performance will shift investments on the "B" curve to the "A" curve. Such managers will make more money in the short-term from fewer assets and will often be promoted to positions in which they can destroy a bigger chunk of the company.

The United States has more than $2 trillion managed by money managers whose job it is to make money for their clients. Making money can be achieved two ways: by shifting wealth or by generating wealth. Real estate investments are a good example of shifting wealth. The idea behind a real estate investment is simply this: The investor is smarter than others in predicting the future value. However, five

years following the investment, the land is still the same as it was when purchased. Thus, if money was made, it was made by shifting wealth.

As a counter example, look at what happens when a new manufacturing business is created. At the end of five years, there are numerous benefits to society: the value of the new products generated, the improvement in efficiency or quality of life of the people who used those products, and the jobs created by the business.

While our money managers invest heavily in manufacturing companies, their investments often have the opposite effect of generating wealth because their focus is on short-term profit. Often, optimizing the short term is accomplished by eating the company's seed corn (e.g., avoiding investing in machinery or research that will keep the company competitive for the next decade), thus reducing its ability to generate wealth.

We should look for tax structures that punish shifting wealth and reward generating wealth.

3. Potential for Conflict

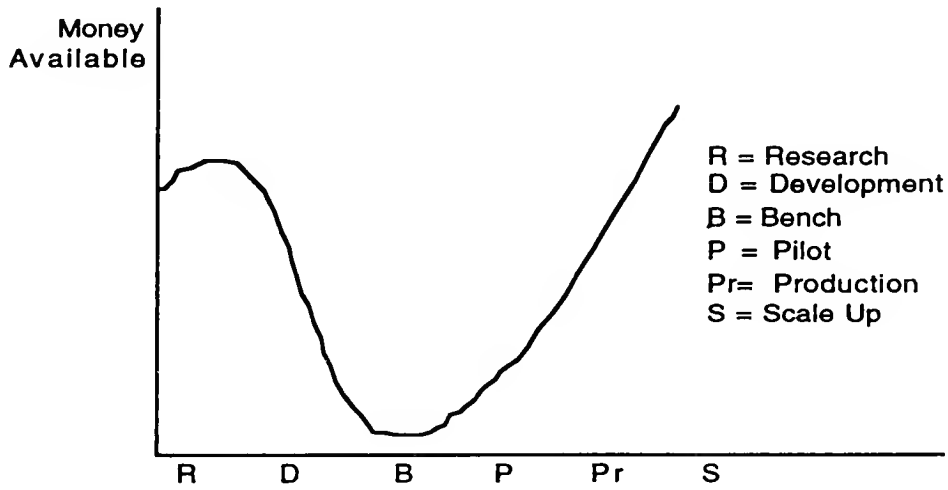
There is a price for economic development. When funds are spent for technology transfer (as in the Small Business Technology Transfer program, Small Business Incentive Research grants and others), there will be greater interaction between government-funded researchers and industry. These interactions often lead to the possibility of personal enrichment. This is generally good for the country because the chance to make money from stock in a startup, or consulting income from an existing company, causes researchers to work more passionately to succeed. This usually means that products get to the market faster and generate more U.S. jobs and wealth.

The problem with such interactions is that occasionally someone will allow greed to bias his or her decisions. When this happens with a university or government employee, there is a potential for conflict. Recently proposed legislation to eliminate the possibility of further conflict (including one proposal that publicly funded researchers should not hold equity in companies commercializing that research) would seriously damage U.S. R&D. Even though it would eliminate a couple of dozen conflicts per year, it would stop the creation of thousands of new jobs. The overreaction would be disastrous, comparable to saying that vaccines should be outlawed because we can prove that for every 100,000 lives saved by a vaccine, one person will have an allergic reaction. It is time that we facilitate positive events rather than let a low-probability evil event keep us from taking action. The only way to avoid conflicts completely is to do nothing. That solution is not economically acceptable.

The U.S. government has the potential to significantly improve the international competitiveness of the country and create domestic jobs. These will be highly-paid, highly-skilled jobs. There is a potential that a few conflicts will be generated by accelerating the interactions between industry- and government-funded researchers, but conflict can be managed, and the good of technology transfer far outweighs the possible negatives. Properly constructed technology transfer programs apply a small amount of money where it has the likelihood to generate enormous benefits.

Figure 1

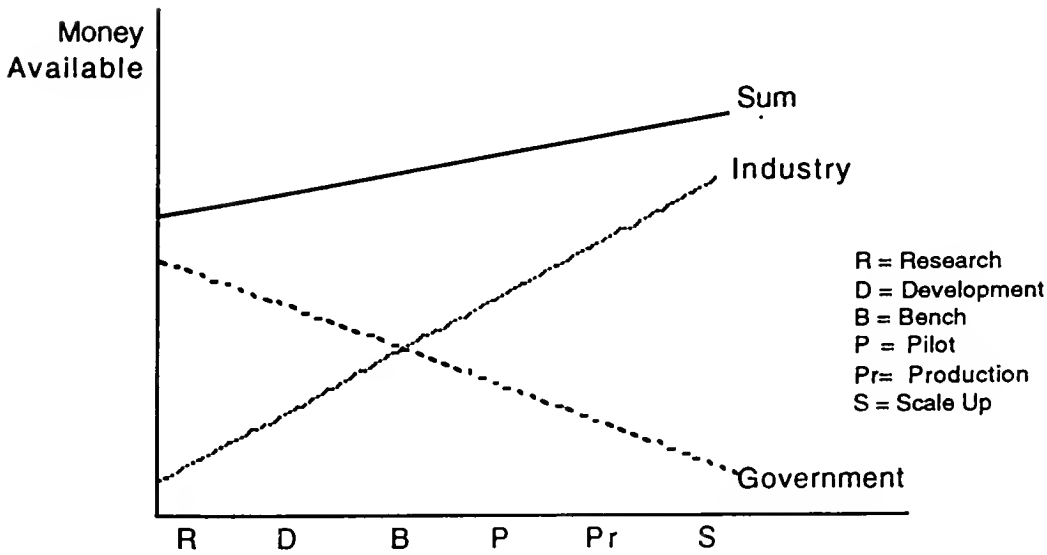
FUNDING GAP



Typical of Industries Like: Environment, Consumer Electronics, Autos, Utilities ...

Figure 2

Industries Without Gap



Typical of Industries Like: Medicine/Biotech, Aerospace '57

Figure 3

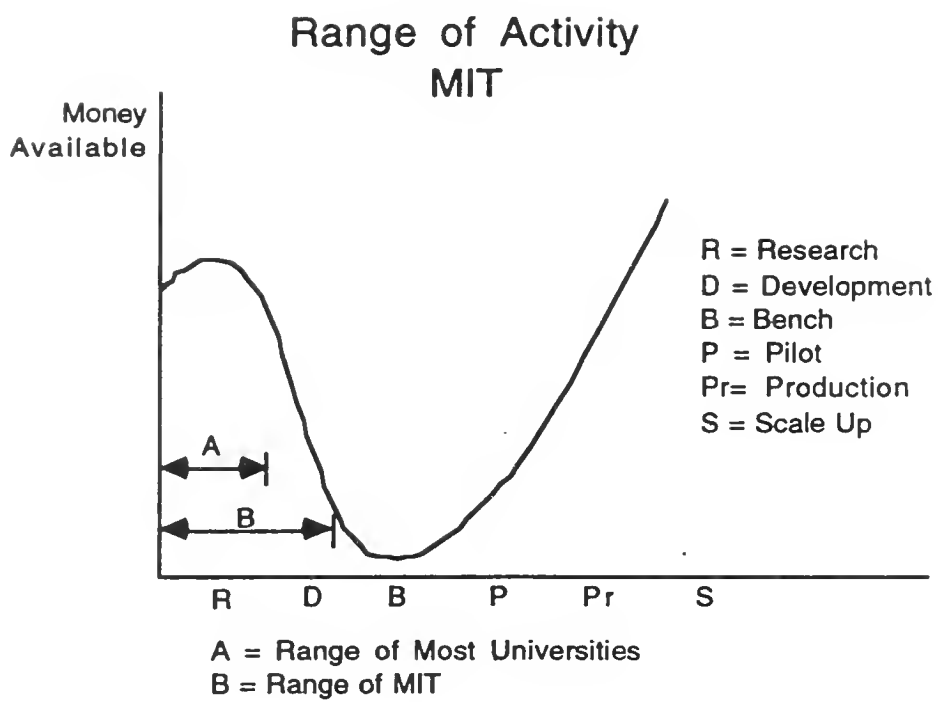


Figure 4

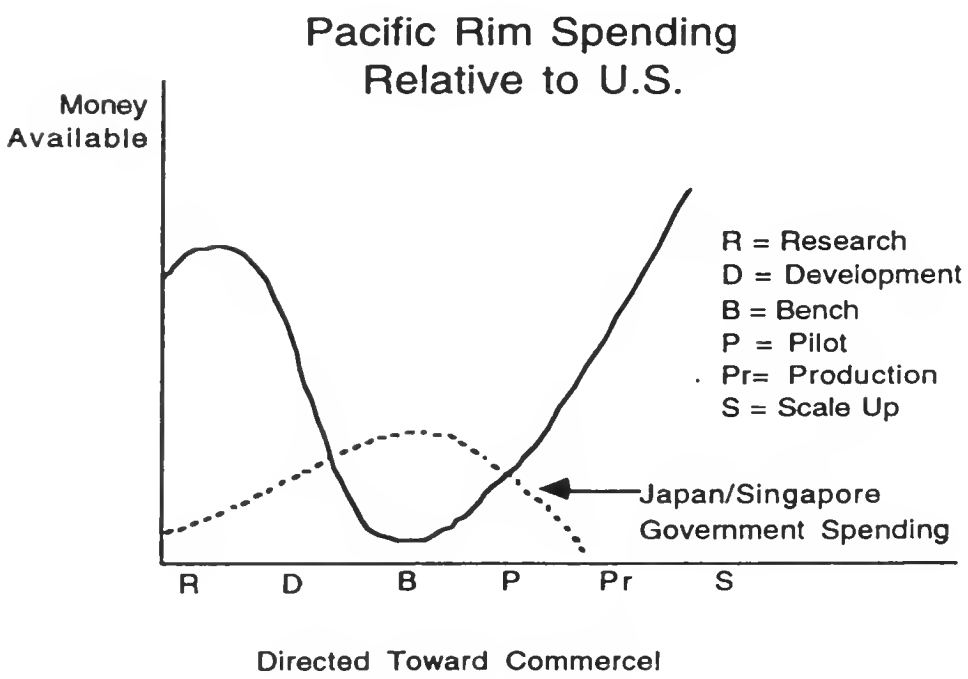
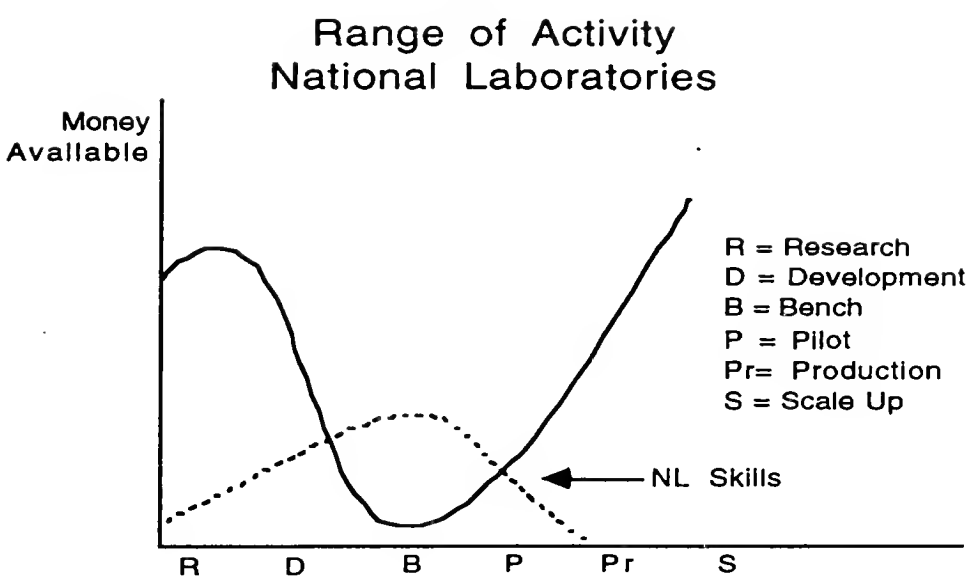


Figure 5



NL Skills Fill the Gap - But Have Not Been Fully Exploited for U.S. Commerce

Figure 6

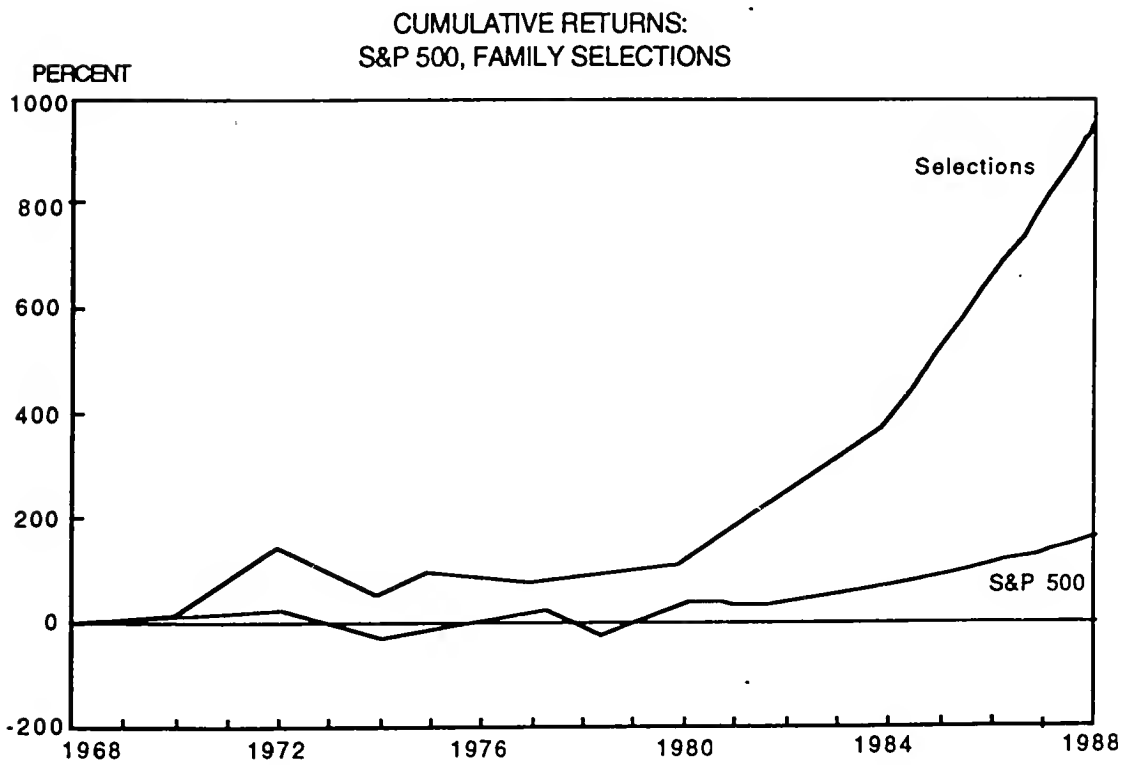


Figure 7

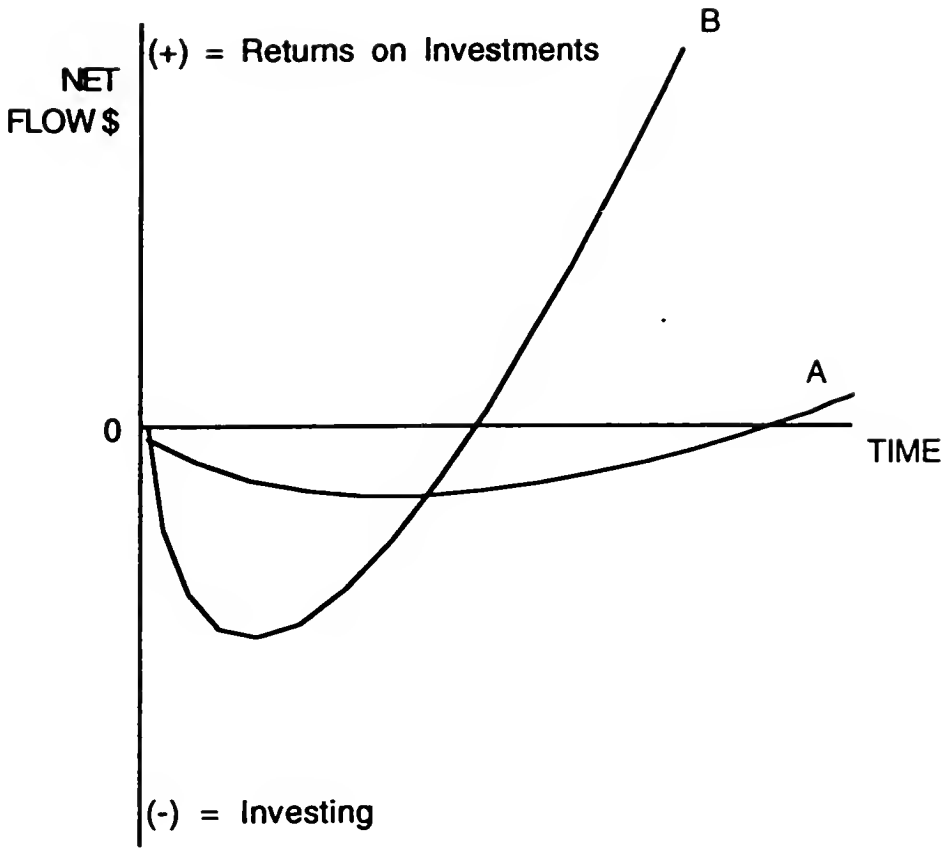


TABLE 1

TECHNOLOGY TRANSFER AGREEMENTS CREATING, OR ASSISTING IN THE CREATION OF START-UP COMPANIES SINCE JULY 1, 1984

	Public	Employment
1984		
Cirrus Logic, Inc.	Y	600
1985		
Kopin Corporation	Y	60
Rheocast Corporation		
Thinking Machines Corporation		500
1986		
Axiomatics Corporation		
Medic Monitor, Inc.		
Micrion Corporation		70
Osteo-Technology, Inc.		
Organogenesis, Inc.	Y	90
1987		
Biomat Corporation		
Biosurface Technology, Inc.	Y	95
Ergo Computing, Inc.		
Immulogic Pharmaceutical Corporation	Y	150
Mattek Corporation		
Thermal Technologies, Inc.		
Xenos Medical Systems		
1988		
Alpha-Beta Technology, Inc.	Y	86
American Superconductor Corporation	Y	75
Applied Biotechnology, Inc.		
Diamond Materials, Inc.		
Eidak Corporation		
Enzytech, Inc.	Y	45
Equine Biomechanics & Exercise Physiology, Inc.		
Matritech, Inc.	Y	40
Microdrop, Inc.		
Neomorphics, Inc.	Y	22
Oculon Corporation		
Paranomics		
Somatix Therapy Corporation	Y	100
Therion Biologics Corporation		

1989		
Celadon Corporation		
Faradaics, Inc.		
Instrumar, Inc.		
Interneuron Pharmaceuticals, Inc.	Y	25
Proteinix		
Transgenic Sciences, Inc.	Y	180
Xsirius Superconductivity, Inc.		
1990		
3-Space Motion, Inc.		
Amira, Inc.		
Arris Pharmaceutical Corporation		
Beyond, Inc.		
Boreas, Inc.		
Convolve, Inc.		
Micracor Corporation		15
Queues Limited		
Thixomat, Inc.		
Volumetric Imaging, Inc.		
1991		
Ariad Pharmaceuticals, Inc.		
Coastal Partners, Inc.		
Comtech Labs, Inc.		25
1992		10
Exa Corporation		
Gel Sciences, Inc.		
Geltex		
OneCell Systems, Inc. (formerly Microdrop)		
Polykinetix, Inc.		
Soligen, Inc.		10
Vazorx, Inc.		
Virus Research Institute, Inc.		
1993		
Cubist Pharmaceuticals, Inc.		
Infinite Grafics, Inc.		
Ingenex, Inc.		
Myco Pharmaceuticals, Inc.		
Silicon Video Corporation		
Stephen E. Librande		

National Strategies for Technology Commercialization

John T. Preston and David H. Staelin

December 30, 1993

INTRODUCTION

One of the first actions of the Clinton-Gore Administration was to issue broad guidelines for restructuring our federal technology engine. Specifically, the U.S. government spends approximately $70 billion per year on research and development. Before the end of the Cold War, the primary purposes of federal research were military (e.g., electronics, avionics, advanced materials, etc.), energy, health and advancing basic sciences, with military research accounting for the majority of the expenditures. Now President Clinton, working closely with the Vice President, intends to shift research investments such that roughly half of the total budget is directly applicable to commerce before the end of his first term as President. This paper proposes strategies for redirecting research and development to optimize job and wealth creation in the United States. In particular, we must create incentives for industry to adopt technology while motivating our laboratory and university generators of technology. We have the most powerful technology and innovation engine in the world - it is just slightly off track.

EXISTING STRUCTURES

Currently, the government has three primary structures for directly stimulating industrial development of technology: competitive bid grants, co-development and consortia. These are in addition to broad financial incentives like corporate tax reductions for independent research and development and capital gains tax breaks.

Competitive Bid Grants and Contracts

Grants given to industry based on competitive bids include Small Business Innovative Research Grants (SBIR), Advanced Technology Program grants (ATP) and Technology Reinvestment Program (TRP) awards. These programs solicit competitive bids for government funds where such bids are reviewed by experts based on i) the merit of the idea and ii) the reward to society if the idea works. These programs have clearly benefited Americans by accelerating the commercialization of technology. However, competitive bidding faces severe limitations. First, these programs are limited in how fast they can respond to emerging technological opportunities. After the opportunity is recognized by a company, someone must write a grant proposal. This activity is usually foreign to the individual. Furthermore, proposal preparation must be accomplished while keeping up with all other tasks which are typically more urgent. Thus, there is usually a delay at the company in preparing the proposal. Next, the proposal must wait for a review cycle which occurs once or twice a year. Finally, the review process and selection adds another delay, although this is relatively short as most government agencies have made excellent progress in reducing the selection process to only a few months. All three sources of delay can, however, be significant, particularly in industries where international competition causes rapid rates of

technological change. These rapidly changing industries are usually the ones where we most need technology development. Furthermore, a firm's alternative funding or teaming arrangements may be put on hold, or critical staff may be lost during the waiting period.

The second problem with competitive bid projects is that some companies abuse the system by making winning the bids a higher priority than commercialization of the technology. Companies with staff specialized in winning bids have an advantage over companies focused more on commercialization. Such bid-focused efforts often fail commercially, even if the technology is excellent. The government is starting to address this problem by placing greater emphasis on the commercialization plan outlined in the bid. However, most bid reviewers are researchers who are not sophisticated in technology commercialization and the potential for abuse remains high. On the other hand, hiring reviewers who are highly skilled in technology commercialization is not always a viable solution because such reviewers are scarce and could be a perceived or real threat to the company submitting the proposal. Such reviewers would be the people best able to take the idea and compete against the bidder. Finally, the reviewers generally base their decision largely on a written proposal without face-to-face meetings. This limits the transfer of knowledge. Close personal communications are usually required to evaluate the probability of commercial success. For example, an entrepreneur's passion for success might be more important than the quality of the technology. It is hard to gauge passion based on a written proposal. No venture capitalist would fund a business without meeting the founders and without continuing interactions after funding.

The third problem with competitive bid programs is that the cost of the process can be high relative to the return. Take for example the following scenario. Suppose seven companies are bidding for a $75,000 SBIR grant. Each devotes significant time and effort preparing the application at an average cost of $10,000. After reviewing each proposal, the government awards one $75,000 grant. If we now weigh the cost relative to the benefits, we would conclude that society did not really gain from this transaction because the cost of winning the money was roughly the same as the money won. Actually, the above scenario could be viewed as even worse because we factored into the equation neither the costs of running the SBIR program nor the value of the time donated by the reviewers. If we wanted to be generous in the above example we could allocate an educational value to the proposal writing and reviewing processes. Nevertheless, it is clear that the lower the amount of the award and the higher the rejection ratio, the lower the end value is to society. It should also be noted that giving many small grants is politically more popular than giving a few large grants, which further fuels this problem. Furthermore, many small efforts might be worse than a few significant efforts which leapfrog our competitors. Currently, SBIR Phase-1 programs are averaging one $75,000 grant for every four applicants while the APT program is averaging nearly a $2.5 million dollar grant for every ten proposals.

Industry/Government Collaborations

A second structure for technology development is collaborative efforts between industrial technologists and government researchers. These relationships were fostered by the Stevenson Wydler Technology Transfer Act of 1980 and its amendments, and most commonly take the form of a Cooperative Research and Development Agreement (CRDA). Under a CRDA, government researchers assist one or more companies with technology

development. Thus, any U.S. company can approach any government lab requesting assistance, and if mutually acceptable, enter into a CRDA. Usually, the company is allowed to take ownership of intellectual property generated by the government, including some right to suppress publications. As in the case of competitive bid grants, we can see a clear win to American taxpayers with major limitations. The win is two fold. First, connecting government researchers with industry technologists greatly increases the probability of useful results. As any good businessman knows, talking to your customer injects relevance, improves products and provides ideas for future products. Second, the actual collaboration often leads to more competitive products.

The biggest problem with CRDAs is that the process does not always promote passionate behavior on either side - the company or government lab. Before receiving the award, the company's risks are so high that they may be indifferent (except for companies that are so passionate they are funding the project themselves and seeking government funds only to accelerate development). After receiving the award, the company passion for results may remain low because there are few risks associated with failure to move the technology into commerce. Although CRDAs usually require matching funds from the company, the definition of matching funds is so loose that expenditures which would have occurred without the CRDA can be re-labeled as "matching." In fact, corporate funding could conceivably even decrease when entering into a CRDA. For example, a company spending $500,000 to develop a technology might then find a government lab that is willing to collaborate on a one-for-one matching basis with all intellectual property going to the company. The company can now drop its internal expenditures to $300,000 and, with the government's matching effort, increase the overall project commitment to $600,000 while saving their shareholders $200,000.

While there is no evidence that the above (cynical) scenario has occurred, the post-award structure of CRDAs contains low risk on the part of the company. Agreements which contain no risk often yield mediocre results because of a lack of passion. If, on the other hand, intellectual property was licensed to the company with exclusivity contingent on having a product on the market within a reasonable time, and reaching minimum sales thereafter, the company would be more determined to succeed. This is particularly a problem with large companies. Small companies whose whole existence depends on the success of the project do not have the above problem -- their passion cannot be higher.

Finally, the government labs can easily be seduced into believing that the CRDA itself is the goal instead of more competitive products. We are now seeing evidence that the government labs are measuring their technology transfer success by the funds devoted to CRDAs. As one of our colleagues put it, "CRDAs are like standing on the street corner offering to give $5 to everyone that has a matching $5 in their wallet." Missing from the above quote is the notion that we want something good to be accomplished with the $10. We must refocus on the importance of job and wealth creation, rather than counting the dollars. Otherwise, our labs will rush to do many CRDAs without adequate commitment for success. We do not want success to be achieved in their minds only when the funds are awarded. Without commitments to make more competitive products, CRDAs will burn money without results.

Industrial Consortia

The third major structure for government/industry technology development is industrial consortia. Under this structure the government provides money to induce an industry to collaborate on finding solutions to shared problems. SEMATECH, a consortium of U.S. semiconductor manufacturers, is an example of such a consortium. Again, we have a structure with flaws, but which in balance, has provided a reasonable return for American taxpayers. Annual government contributions of approximately $100,000,000 are credited by many for a resurgence in self-confidence in U.S. semiconductor manufacturers and in their strengthened bargaining position in international cooperative venture negotiations. This consortium model for boosting the semiconductor industry has been applied by governments in Japan (through MITI) and Europe (JESSI).

By pooling resources, including government funds, SEMATECH has critical mass and the resources to create a first-rate effort to innovate. Otherwise we might have several sub-critical efforts. One reason for SEMATECH's relative success is that it is focused on problems that are core to the industry, but do not constitute the "crown jewels" of the member companies. Each semiconductor company views its circuit designs, microcode and maskworks as the heart of its business and thus secret to the company. Collaboration on such critical technologies is nearly impossible because communication is stilted at best. Several consortia have failed to commercialize new technologies because they attempted to work on the "crown jewels."

Companies also resist being first to adopt technologies for which all consortia members have rights. The formation of such consortia is easy. Each company contributes a small amount of money and gets non-exclusive rights to intellectual property generated by the entire pool. The problem is that the cost of commercializing new inventions is higher to the first adopter than it is for the second company. Thus, the members of the consortia have an incentive to sit on the side-lines waiting for someone else to pay the price of blazing the trail and then follow with superior economics. Everyone wants to be the first to be second.

NEW INITIATIVES

Motivate Industry

The effectiveness of technology commercialization can be greatly enhanced by creating incentives for industrial adopters of technology. To put this in perspective, compare the total annual U.S. government investments in research and development, $70 billion, to the money invested by pension funds, $2 trillion, which is growing about ten percent annually. If we can find ways to reward investments in technology commercialization, the pension assets alone can have much more impact than modifying the way we spend the $70 billion. Another way to think of this is that changing the behavior of investors will translate into market pull, whereas redirecting the government research and development more toward industry is technology push. Both are good activities, but market pull could, in principle, motivate technologists more than any top-down directive.

Unfortunately, the strong preference of U.S. industry for short-term investments over long ones has systematically weakened U.S. initiatives in many basic industries such as steel, consumer electronics and automobiles.[1] As noted by Dertouzos et al.[2], managers of firms in nations with relatively high cost of capital are forced to favor short-term investments over long-term ones because only then can advantages in a firm's skills provide investment returns superior to competitors. Any differences in cost of capital become negligible for investments leading to returns in less than a year but can dominate long-term investments.

The short term problem is driven not only by the cost of capital, but also by the time horizon of corporate investors. As shown by Cunningham and Preston[3,4], companies with large blocks of shares held by individuals who are active in the company outperform broadly owned companies. The difference in performance is driven by the fact that the individual owners want to optimize the long-term (e.g., give their shares to their children) and they own enough of the company to influence long-term projects. These owners have the vision and the day-to-day hands-on involvement to successfully move projects into commerce. Government incentives favoring longer term investments include use of tax-free bonds for financing, tax credits for long-term capital investments, reduced capital gains tax rates, investment-specific loan guarantees, significant assured government purchases and other measures. Our interest here, however, is in a more focused approached.

Address The Gap

For most industries, particularly the older, physical science industries like auto making, utilities and consumer electronics, there is a gap in funding technology commercialization. Specifically, this gap is between the point where the government considers the technology too applied for additional funding and industry considers the technology too embryonic to adopt. Often, our foreign competitors have been more aggressive to develop these technologies before we do and have established significant competitive advantage.[5] There are many ways to motivate industry to help fill the gap. Clearly, rewarding investments that have a long-term payoff would shift investments into the gap. This has been the general idea behind capital gains taxes, for example. Intuitively, we have known for years that long-term investments create jobs and wealth. It is, however, probably under appreciated how destructive short-term investments can be. For example, one way to optimize the short term is to eat one's seed corn -- to reduce investments in capital equipment and research and development to show better short-term results. If we were to sufficiently reward industry to invest long-term, we would not need to encourage interactions between industry and our national labs and universities. Industry would be constantly searching them for new ideas.

Modify Capital Gains Tax

The greater the tax differential between profits on short-term investments and long-term investments, the more we can influence job and wealth creation. Currently, our tax structure does not have a big enough differential. Note, it makes no difference whether long-term taxes are lowered or short-term taxes are increased. Politically, we favor both lowering long-term taxes and raising short-term taxes. The reason is that most people view capital gains tax reduction as a benefit for the rich, which it clearly is - but it is also a benefit for all

of us who want jobs and wealth in the U.S. However, raising short term capital gains tax negates the argument that we are preferentially benefiting the rich by lowering capital gains tax. Furthermore, our capital gains tax structure is misguided in that we treat investments in real estate and art the same as we treat investments in manufacturing companies. We should reduce or eliminate tax breaks for investments that do not generate jobs and wealth, and increase tax breaks for businesses that create jobs and wealth, with the highest priority on high tech manufacturing. This strategy generates jobs that will create the highest, sustainable benefit to society.

Establish R&D and Capital Equipment Tax Credits

If we were to give corporate tax credits for research funded at a university or government lab or investments in capital equipment, we would also move industrial money into the gap. R&D tax credits would move resources into the early stages of the gap, while capital equipment tax credits would move money into the middle and later stages of the gap.

A New Program for Government Gap Funding

Any new government program to fund technology through commercial proof-of-concept should solve the problems discussed above. Specifically the program should:

1) be directed towards economically critical technologies;
2) be rapid and efficient, avoiding excessive industrial generation of unfunded proposals;
3) provide incentives for success via intellectual property rights and milestone funding;
4) be independent of politics;
5) eliminate potential complaints from unfunded companies; and
6) promote competition between grantors in addition to grantees of government funds

One mechanism to accomplish this is for the government to "hire" the private sector to grant technology commercialization funds instead of the government. For example, suppose the government granted $50 million each to six private non-profit organizations with the commitment to spend the money on projects, typically at other firms, to develop technologies that would increase U.S. competitiveness. These six organizations would behave like venture capital funds. However, since they are not investing for financial returns, they would be free to grant money to large or small organizations with the sole objective of improving U.S. competitiveness. Potentially such a program would solve the problems with existing programs and provide a more effective method to fund technology commercialization. The entities chosen as grantors would compete for the right to manage government funds and would be judged on the basis of U.S. job and wealth generation. The authorization to manage government funds could be revolving or be increased based on the track record of these private entities at improving U.S. competitiveness. The entities should be free to utilize the funds in any way they see fit to optimize the goal of utilizing technology to create jobs and wealth in the U.S., except that they might have restrictions on internal use

of funds. This flexibility would include the right to leverage the federal dollars with matching private sector investments or loans used to move the technology through the gap.

The private entities might include a mixture of for-profit, non-profit and other organizations with strong records in technology commercialization. To minimize the potential for conflict, i) the for-profit entities should not include manufacturing firms which would apply the money internally, and should be further limited as to the percentage of the total return which they would be allowed to retain as management incentives, and ii) the non-profit entities, such as a university or government laboratory, might be limited with respect to the fraction of the funds they could expend internally. This approach of using private grantors of government funds should reduce complaints from companies whose competitors were funded. For if those protesting companies were truly competitive as technology developers, they should have been able to persuade at least one of the investment groups to team with them. If there were only one investing entity, then there would no longer be a free market and concerns about the government picking winners would apply. This proposal requires that each private investing entity must have flexibility to compete and should not be limited regionally or in other ways. The mechanism for motivating long-term over short-term investments would be that continued government support of these investing entities would be contingent on their long-term impact on industry (i.e., job and wealth creation or retention).

It is important that political interests be removed from this activity. Such separation could be provided through prohibitions against congressional or executive intervention in private-entity decisions, except through broad policy statements. Competitive pressures for performance would mandate the entities' efforts for timeliness and efficiency in interacting with industry.

The most important innovation in this proposed new government initiative would be to introduce more competition into the government fund granting process itself -- to thereby promote both innovation and excellence in it. Such competition should first be with respect to the demonstrated qualifications of potential grantors to promote innovative industrial growth, as evaluated by neutral peers, and later with respect to their evolving track record as their investments mature. These are exactly the criteria by which venture capital firms compete with each other. True competition requires that multiple agents be free to invest in the same areas.

The best entities to manage government funds would have a thorough understanding of technology and business. Such entities could include government, university, and non-profit laboratories, and technology-based venture capital firms, preferably in combination. Government laboratories have broad expertise in technology, but few have much industrially relevant technical breadth today at world class levels. A few universities and independent federally funded research and development centers are more fortunate in this regard, and are capable not only of evaluating technical proposals, but also of adding innovative world class technology of their own to the enterprise. For example, the Massachusetts Institute of Technology (MIT) has spun off hundreds of successful high technology firms with annual sales today totaling tens of billions of dollars[6]. In the last ten years, MIT has created dozens of new firms and granted several hundred licenses to existing firms. This performance was driven by proactive patenting and licensing activities by people skilled in both technology and business who match inventors with entrepreneurs and venture capital firms or corporate

investors. Some venture capital firms have also established excellent high-technology gap funding track records.

Any such program should not replace existing programs. It should however, augment or extend these programs. In fact, SBIR, ATP and TRP staff could play a role in administering the competitive process which selects private entities to manage government technology funds.

CONCLUSIONS

The United States today has a unique opportunity to revitalize its economy through partial conversion from a military-oriented technology development strategy toward one aimed more broadly at economic development and productivity. The benefits could accrue not only from the more useful orientation of these investments, but also from improved efficiency in their placement. Improved efficiency would be achieved through increased use of success-demonstrated competitive processes rather than through use of government entities and decision making processes chosen more for reasons of administrative convenience or political appeal. Improved productivity should also result from more apt incentives for the private sector rather than direction of it. The need for better utilization of technology is global, and the issues addressed in this paper should apply to any national economy sufficiently free and competitive that multiple competent technology producers exist.

NOTES

[1] Preston, J. T. 1993 "Embrace Technology, Think Long-Term." *Connection, New England's Journal of Higher Education and Economic Development* 8 (3): 26-27.

[2] Dertouzos, M. L., Lester, R. K., Solow, R. M., and The MIT Commission on Industrial Productivity. 1989 *Made in America, Regaining the Productive Edge* MIT Press.

[3] Cunningham, D. Mark. *Working Capital: Dollars with Sense*, unpublished manuscript.

[4] Preston, J. T. 1993 "Success Factors in U.S. Technology Development." *Industry & Higher Education* 7 (4): 207-215.

[5] Preston, J. T. 1993 "Key Problems in Commercializing Technology in the U.S." *Testimony Before the Energy Subcommittee of the House Space, Science and Technology Committee*. March 23.

[6] *MIT: Growing Business for the Future.* 1989 Boston: Bank of Boston, June 1.

Mrs. MORELLA. Thank you very much, Mr. Preston.

What we're going to do is, I will go vote so that Chairman Schiff will take over so we don't lose any time. Thank you.

Mr. SCHIFF. I want to advise members that because we have three panels, that Ms. Morella and I are going to continue the hearings, so members should leave to vote as they see fit. And on their return, we'll just continue the questioning, rather than interrupting what may be a lot of interruptions here today.

For the purpose of questions, I'd like to recognize Congressman Tanner, the ranking member, I might add, of the Technology Subcommittee.

Mr. TANNER. Thank you, Mr. Chairman.

I was particularly interested in what Mr. Allen had on page 3, when you say, "Unless we devise objective methods for evaluating the economic benefits derived from the spectrum of laboratory university industry, state government interactions, it's difficult to make judgments."

And also, Ms. McKinley, on page 6 of her statement, if I can find it, when you talked about the performance metrics. I'd like to explore that area with all four of you for a minute, because I think it goes to the heart of what we're dealing with.

And that is, number one, we know we have to do it. And I was particularly pleased to hear Mr. Preston's comment about, this is not something that is a luxury. This is not the government picking winners and losers. This is not about corporate welfare, as some of the rhetoric in this town has suggested in recent times.

This is about the United States remaining competitive and utilizing the brightest minds and the best science that we have available in laboratories and universities to make them, to enable them to help make our economy competitive with those in the rest of the world.

That's how critically important this hearing is, and what I was trying to say. So with that background, could I ask you what suggestions would any of you have with regard to how we measure performance so that we can make our case, those of us who believe in this program?

Mr. ALLEN. Since you started with me, maybe I'll start. You notice I posed the question, but I didn't answer it in my testimony.

Mr. TANNER. I was trying to be kind.

Mr. ALLEN. You were, thank you, as people from Tennessee generally are.

The hardest thing to do is to really get an objective measure from the system. The old measure used to be, before the Federal Tech Transfer Act, was how many documents did you get out?

That's not a particularly good measure, and our friends in Japan love to get those. That was one of the biggest exports we had, was giving the stuff away.

What I would caution is to look for market-driven measures whenever you can. As a former bureaucrat, whatever you want to measure, we will always come back and say, "We're doing wonderfully at that." You need something you can really look at to really quantify. So things like licenses or royalties is a good place to start.

Having said that, though, the biggest draw on the federal lab system, which is certainly true of Oak Ridge and every other lab

I've looked at, is technical assistance, companies calling up, particularly small manufacturers, with shop floor problems. That is very, very hard to quantify.

And if you look at the industry poll side, which a lot of the members rightly cited, that's where industry's really pulling, and that's where the expertise resides.

Frankly, I don't have a good answer for that. It's a hard thing to really say, "How much did this really save you?" But if you look at the whole federal labs spectrum, you don't want to leave that part out.

Ms. MCKINLEY. Joe may have presented one question in his testimony. I presented two. I don't have answers for those two either, I'm sorry to say. I agree the question is whether you're measuring impact or process.

Certainly with respect to evaluation, we have to go with customer satisfaction measures. Who are the customers? The private partners are the customers. The taxpayers are also the customers. The agency and the laboratory missions continue to remain paramount.

What is it we're transferring? Hardware, software. When you get to expertise within people's heads, that's a much harder thing to assess.

If we have saved a small business a substantial amount because we've improved its process control, that cost savings should be reported as a result of the technical assistance that was received from the laboratory. But how do we ensure that in fact that happens?

I think, as you are aware, all of the agencies right now are taking the need to define performance metrics as one of the most important needs that they are facing. And they're working very hard to assess those metrics that can be used consistently across all of the agency laboratories, and those areas where the metrics must differ, because the missions differ.

We don't have answers right now, Mr. Tanner. But we wholeheartedly concur that the importance of developing and using consistent metrics to ensure that what we're doing remains valuable to our customers and our taxpayers is critical.

Dr. TEMPLIN. As we're looking at the expenditure of public resources, the question is, what is the return on the investment, after all of the years and the millions and billions of dollars? States are asking these questions, too, with regard to the investment they're making in their universities and in their third-party technology transfer organizations.

We don't come close to answering the question yet. But there's an outline of some things that are emerging.

First, we're in Virginia beginning to track all of our customers that have contact with the system, and we follow long-term and ask, "What about customer satisfaction and responsiveness and thoroughness and completeness in the way that we respond?"

Secondly, we monitor the activity, and they enter into an agreement with us to do this, to follow their financial activity, their investment of capital, their rolling out of new products, the creation of new jobs and new products.

Consequently, for us, increasingly we're trying in Virginia to get the measures to pinpoint the three areas. What have we done to create, retain, or to convert from defense dependence to private sector jobs? Jobs, companies, and competitiveness—those are the three indicators that I think really tell the taxpayers in terms they understand whether or not the investment is worthwhile.

Several of the states have embarked on an effort to develop a baseline, and to develop the metrics for that. I hope Virginia has a solution within 18 months. We've started the tracking system now, and we're pleased with the collaboration that we're receiving from businesses, and their understanding to provide us the information.

Mr. PRESTON. There have been a number of studies to try to put some metrics on these answers, the question which you're raising.

Clearly, when you have spinoff companies, it's easier to account, because you say, "If that company didn't exist, those jobs wouldn't exist," and you could measure the revenues and the job creation.

And there have been studies done, you know, showing for example MIT spinoff companies—in Massachusetts alone, 636—$40 billion in revenues in 1988. That's a huge percentage of the total economy of Massachusetts. And it's great when the university focuses on spinoff companies.

We just recently looked at a study of—I'm not sure of the number. But I think it's about 18 biotech companies that have spun out of MIT. We're estimating. This is just since 1986. Private investment in those firms is about $720 million on 18 spinoff companies. That's a huge private sector investment.

There was a study done last year by the Association of University Technology Managers, which are all of our counterparts at all of the universities in the U.S. And they found that royalty income to U.S. universities last year was $300 million, which translates into about $30 billion worth of sales, if you average one percent on royalties, which translates into about 300,000 jobs that can be tied directly to those license agreements.

But as Joe points out, that's only the tip of the iceberg, because we don't have any good metrics for some of these more informal types of technology collaborations. But at any rate, it is an area being studied. And there are some data coming in right now, and all of the data are very encouraging, and support the notion that this should be the highest priority in the country.

I think this is, as you said, the most important hearing that's going to be held in this room in awhile.

Mr. TANNER. I have some other follow-up, but I understand we're operating under the five-minute rule. I think my time is over, and I appreciate your courtesy. Thank you.

Mr. SCHIFF. Thank you, Mr. Tanner.

Well, much as I tried to avoid it, we have about five minutes left until the vote on the House floor. Ms. Morella will be back just in a moment to resume the chair.

Let me point out for those of you who have not participated in this process, the comings and goings of members of Congress may be a bit disconcerting. But you see the person with the mask over there is not here to rob us. The reporter is making a record of this hearing which will be available to the entire Congress. So even

though we may come and go, I assure you that your testimony will be considered.

I'm going to declare a short recess until Chairwoman Morella gets back and ask if you could just stay about where you're at. We'll recess for about five minutes.

[Recess.]

Mrs. MORELLA. I'm going to reconvene the hearing. I think it was kind of the pause that refreshes a lot of people to see who else is here in the committee room and to chat with some of them.

I'd like to now turn for any questioning or comments to Ms. Jackson Lee.

Ms. JACKSON LEE. Thank you, Chairwoman Morella.

If I might ask—and I was looking—Mr. Allen, you're not in the same seat you were, but you are here.

Mr. ALLEN. Yes, ma'am, as far as I know.

Ms. JACKSON LEE. That empty chair is not you, so very good.

Let me first start with Ms. McKinley, who mentioned the tentative role possibly for the federal government. If you would, why don't you give me a very brief framework, maybe, of your perception of how best the federal government plays into the partnership?

I know funding is certainly a component, but what framework do you see works best as we look at establishing a path for us in the next century?

Ms. MCKINLEY. That's a very large question. And I will do my best to try to respond to all aspects of it if I can.

First and foremost, I agree with the earlier comments by panelists that the partnerships have got to be market-driven. One of the things that the laboratories and the agencies have learned over the last two decades is that it's not just sufficient to send up information about the technologies that are available out into the world and expect partnerships to develop.

You have to do that to a certain extent, because the potential partners have got to know enough about the kinds of expertise and technologies that are potentially available, so that as they define their technical needs and opportunities for working together, they can determine where the labs or the agencies may be able to help.

So there has to be a consistent and comprehensive sharing of information about what's generally available. That has to be done to an extent that the awareness level is raised within the potential partner population, so that then they can come to the agencies and the labs, and they can talk about what their needs are.

In order for the laboratories then to be able to respond, there has to be a working knowledge among the general employee population, particularly the technical employee population. People have to be convinced that technology transfer is the way that research and development is incorporated into the way that research and development is done in the federal community.

We can't just tack on an industry workshop at the end of a long R&D project and call it technology transfer. That just doesn't work. That means there has to be training. That means there has to be lessons learned. That means that the top level laboratory management has got to concur that this is an important dimension of the mission.

Once that happens, and the technical need is presented by the partner, and there's a response from within the laboratory that they can work and help to meet this technical need, and by doing so also meet their mission, then there's got to be the flexibility and the decentralization that Joe talked about earlier.

The laboratories have got to be able to select from among a range of mechanisms that mechanism that will best work for the situation that's presented. And that may mean a cooperative research and development agreement, or it may mean a personnel exchange, or it may mean the development of a consortium.

But the bottom line is that every situation is different. Technology is different. It's very volatile. The personalities are different. As Mr. Preston pointed out, it has a lot to do with the personalities of the respondent, and the mechanisms selection has got to be able to recognize the differences inherent in every situation.

Ms. JACKSON LEE. If I may interrupt you, and I appreciate the largeness of my question. But as I've been listening, we're talking about a methodical selection that will get us from point A to point B, each step of the way providing the education where the parties involved will be mutually beneficial to each other. Obviously, I can understand that.

Let me just pause then, and go to Joe, who did pick up on my question. And we've had these discussions, the larger science committee, and certainly in my subcommittee here on basic research. And it's space and technology, on the whole question of expanding the opportunities of science.

I notice that you have "marketing" in your title. Sometimes even those of us in government, short of the politics of it all, are a little away from the marketing aspects of what we need to do to inform. I am particularly concerned about a point you made. You made a point of whether or not we have either a workforce or an interest base created for science, and science and technology in the 21st century.

Do we have a market? But do we have the doers? I'm concerned that those doers are reflective of this society and include the traditionally black colleges, but includes all types of individuals, the American Indian, the woman, all kinds, who may not traditionally find this path.

How do we do that? How do we incorporate marketing? And what should we be doing as it relates to this whole federal technology transfer issue?

Mr. ALLEN. That's really an excellent question, because it really shows this is a big issue. You talk about a lot of big issues in Washington. By any stretch, this touches everything we're talking about.

The Navy did a video about technology transfer from the Office of Naval Research. It had Admiral Plyetz telling his people how important this really is, because the other thing, it's been a mixed message, when get down to the bench level, how important this is.

After the video was shown, we had a number of people come back to us. One of the comments that three women made, which I really wasn't aware of, was, that's the first time they'd ever seen a woman in a leadership role in a federal laboratory.

Frankly, I wasn't smart enough to have thought of that. I wish I had been. But that really is important.

We had a delegation from historically black colleges come to Wheeling, West Virginia, which doesn't happen every day. They said, "We're afraid we're getting left behind in this."

There is a shortage of deal-makers. John Preston has a really good talk about the need for public entrepreneurship. These are people with a burn to get things done.

I've always found, I don't care what your background is, I don't care what your education is. If you're smart and you want to get deals made, you'll fit in. If you ask the people at this table, and even in the audience, how many of us that came into public tech transfer, it wasn't even a career path. I just sort of stumbled into it.

We really have a dire shortage of people that can make deals between the public and private sectors.

Also, one thing that Dr. Templin touched on is, what I would like to do is, we're scratching the surface. We're saying, if you make a deal, a cooperative agreement with one laboratory, that's good. There's nothing wrong with that. We should be bundling technologies across different agencies. If you did that now with the legal restrictions, you'd go nuts. With all the reviews and the policies and the bureaucracy.

But when you get down to Dr. Templin's level, when he goes to Virginia Industry and says, "We want to build. We want to spin off companies, build new technologies." They don't care. They want to get the University of Virginia, NASA, the Navy, Army—they want them all at the table. We need to really create those kind of incentives.

And I appreciate also the tone of your question. It's foolish now when you look at states like California, minorities aren't minorities anymore. They're majorities. You need to get people at the table, because we have a dire shortage of people that can sit down and make deals. And we don't want to close the doors at a time when it's wide open right now.

Fifteen years from now, maybe the field will be full. But we do need to get the word out.

And I talk a lot to college students. "This is a growth industry. We need you right now." The doors are just opening. We don't have all the answers.

Ms. JACKSON LEE. May I follow up with just a brief question, Madam Chairperson? Then can you give me your spin? Precisely, you mentioned restrictions. How do we protect consumers in this? If we certainly provide more of an opportunity for this deal to be made, do we want to make sure that our legislation has some consumer aspects in it?

And then also, do we include opportunities for funding or making sure that we educate a base, even though as you've said, you don't have to have the training to come to be in federal technology transfer, but you at least need to educate people to move them in that direction. Should that be components of the legislation?

Mr. ALLEN. Absolutely. In fact, Mrs. Morella in her bills says, if laboratories make money through these deals, they can be spent and they should be spent on training.

Tina and I spent a lot of time on training. It's frankly amazing to me that we've done as well as we have. And we've hardly trained anybody.

I was at a federal facility not too long ago. One of the attorneys there didn't even know the laws had been changed. He wasn't a bad person. The word just hadn't filtered down.

Again, when you've got such a large system, you know, we can't assume the word goes out effectively. But that really is a big issue, which I would suggest this committee undertake, is, you pass the laws. Mrs. Morella's law really caps a lot of things that need to be done. Now people need the tools to put them into play, and that's hard.

This is hard, hard work. It's not easy. This is one of the hardest professions you could ever undertake. But frankly, it's critical.

Ms. MCKINLEY. If I may just add one final comment. We are really at the very early stage of a young art in technology transfer. We're talking about nothing less than the entire interface between where the federal community touches the rest of the world, and laws, bills such as the one that Chairwoman Morella has proposed, and legislation that's already in place.

We have the legislative climate now to do things that we've not been allowed to do before. Your question is extremely critical.

I've been involved with the Federal Laboratory Consortium now for about 14 years. I will tell you that that group, active members, constitutes somewhere between 300 and 400 people, generally speaking, has changed substantially in that time.

We look different, we talk differently. We talk about different things.

The good news about your question, particularly with respect to the pipeline, is it's not too late, because this art is just now emerging, and we're really beginning to define what it is people have to do and know in order to make it happen. We have an opportunity to create the pipeline. And I can assure you that the Federal Lab Consortium and the National Tech Transfer Center both agree that it is critical that we do so, and involve all portions of our population in the process.

Ms. JACKSON LEE. Thank you, Madam Chair.

Mrs. MORELLA. Moving along to Chairman Schiff.

Mr. SCHIFF. Thank you, Madam Chairman.

Let me make it very clear to this panel that right now, today in the Congress, technology transfer is under intensive attack. It is not along partisan lines. There are people who challenge technology transfer in both parties. There are people who defend technology transfer in both parties.

Nevertheless, I want to make it clear that the attack is not based upon budgetary constraints by themselves. Of course, everybody understands, including the laboratories, wherever they might be, that all federally funded programs will be affected in some way by the goal of balancing the budget. That's regrettable, but it's also unavoidable. That's not what I'm talking about.

There are members of Congress who believe that technology transfer philosophically is not an appropriate role for the federal government. And if we didn't have any fiscal constraints, they would oppose technology transfer.

Now, I'm obviously of the opposite belief. I think there's a very strong role for the federal government in cooperation with industry in joint research projects. And what I'd like to ask, that having been said, is, for example, it's my understanding that other industrialized countries have technology transfer, joint ventures, however you wish to term it. I wonder if any of the witnesses can confirm that, from what they're aware of among our competitors?

Mr. Preston?

Mr. PRESTON. I can indeed confirm it. I spent four years on the National Science and Technology Board for Singapore, where I looked at the national plan, not only of Singapore, but of most of the Pacific Rim countries.

And in Singapore, for example, there are nine national labs. All nine are devoted to supporting industry. None of them are for military purposes. One of the nine national labs is doing nothing but helping the hard disk drive industry.

Now, hard disk drives were invented in the United States. I would argue that they've been better developed in Singapore. Seventy percent of the world production of hard disk drives is within 100 miles of Singapore.

And we see that kind of either direct, as in the case of Singapore, or indirect, as in the case of the Japanese system, support given by the government to industry around the world, and especially among our most fierce competitors.

Most people, for example, would think, "Well, Singapore is a little Asian country. People go there for cheap labor." But two years ago, Singapore surpassed the United Kingdom in terms of per capita income. It's cheaper to go to London for labor.

So they're not winning and growing at the rate of 10 percent per year for the last 10 years because they're cheap labor. They're doing it because they're applying technology very creatively in collaboration with the government, industry, and academia, all three of them pulling on the same oar.

Mr. SCHIFF. So for example, for us not to have the same approach would be engaging in the proverbial fight with one arm tied behind our back; is that right?

Mr. PRESTON. Exactly. It's putting us at a competitive disadvantage.

Mr. SCHIFF. Mr. Allen, did you want to add to that, please?

Mr. ALLEN. Just one anecdote. I was on a negotiating team at the Commerce Department with the Japanese. I assure you the Japanese are very high on what we've done in our federal laboratories. You can even ask your next panel how many times you're holding off the Japanese with one arm while you're trying to entice a U.S. company to come in with the other arm?

They gave us language to actually try to put into the U.S.-Japanese science and tech agreement. The Canadians had it in their free trade agreement. It was in GATT. These people are really afraid that someday we're going to wake up and actually get an economic return from this investment. It's unparalleled in the world, and I suggest that we do that.

Mr. SCHIFF. Does anyone else want to add to that?

[No response.]

Mr. SCHIFF. Let me take it a step farther. Another argument—and I find it at times contradictory—is that if there's government-industrial cooperation, either the federal government dominates the marketplace—in other words, businesses will do what the federal government wants to fund, whether they want it or not.

Or the reverse is—and I think contradictory—but the argument is made that, if the federal government is doing what industry wants, the government is subsidizing private business for what private business should be researching.

Let me ask, in the experience you've had in technology transfer from your respective backgrounds, do you feel that it's been an effective program, or are the criticisms that government has been too heavy-handed or too dominated by industry—take your choice—do they have a significant amount of merit?

I'll again look for anyone who wants to respond.

Mr. Preston?

Mr. PRESTON. Well, it's a complex question. I think that the evidence is not necessarily that the government has been too heavy-handed. The most successful technology transfer programs seem to be the ones with the least regulation.

If you'd like, I'd like to use a couple of quick slides to just amplify on this point.

Mr. SCHIFF. I ask unanimous consent for about a couple more minutes. Thank you. Please go ahead.

Mr. PRESTON. I'll go very quickly.

Mrs. MORELLA. I was going to recognize you later, Mr. Preston, so this is great that you do this now.

I hope it works because I love that big screen concept.

Mr. PRESTON. I want to show you some data, and I apologize that this doesn't tip up higher. But I want to show you some data comparing the multimedia industries in the U.S. and Japan.

This is interesting, because here we see Japan lagging the United States. These data were put together by Mr. Yukawa at Mitsubishi, and they're 1993 data that show the U.S. adoption of multimedia technologies far ahead of the Japanese.

In fairness to Japan, we should double their numbers to normalize the population because they're half the population of the U.S. But even if you double the numbers—for example, you see use of information services in the United States in '93 was $35, only $5 billion in Japan; home shopping, $2 billion to $100 million, and so on.

You look at the number of PCs—70 million in the U.S., 10 million in Japan. Only 10 percent of theirs are networked. Fifty percent of ours are networked. Yukawa was trying to figure out why are the Japanese lagging the U.S. in adopting this innovative new technology.

MULTIMEDIA

MARKET	US	JAPAN
CATALOG SHOPPING	80B	8B
HOME SHOPPING	2B	0.1B
VIDEO RENTAL	16B	2B
CABLE TV	23.5B	0.5B
INFO. SERVICES	35B	5B
NO OF PC'S	70M	10M
% PC'S NETWORKED	50%	10%

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RULES IN JAPAN

1. MINISTRY OF HEALTH
   - NO DRUG SALES OUTSIDE DRUG STORE
   - DOCTOR MUST BE FACE TO FACE WITH PATIENT TO MAKE DIAGNOSIS AND TO CHARGE FOR SERVICE

2. MINISTRY OF TRANSPORT
   - NO TICKET SALES OUTSIDE TRAVEL OFFICE

3. MINISTRY OF EDUCATION
   - NO CREDIT FOR LEARNING OUTSIDE CLASS

4. MINISTRY OF FINANCE
   - NO BANKING OUTSIDE BANKS AND BANK HOURS

5. CORPORATE LAW DOES NOT RECOGNIZE:
   - TELECONFERENCED BOARD MEETINGS
   - WORKING AT HOME (INSURANCE & LABOR STANDARDS)
   - ETC.

SLIDE 2

Mr. PRESTON. He looked at the rules that existed in Japan, and found that the regulations, the government was being too severe in terms of too heavy-handed, to quote Mr. Schiff.

For instance, the Ministry of Health made it illegal for doctors to perform a diagnosis unless they're face to face with a patient. If Mass General Hospital—I can show you doctors performing diagnoses via satellite links with Riyadh, Saudi Arabia, and San Juan, and Mexico City.

They also made it illegal to buy drugs outside of a registered pharmacy. The Ministry of Transport prohibits the sales of tickets outside the travel office. We can buy them on our home computer on Prodigy right now, shopping for the best price.

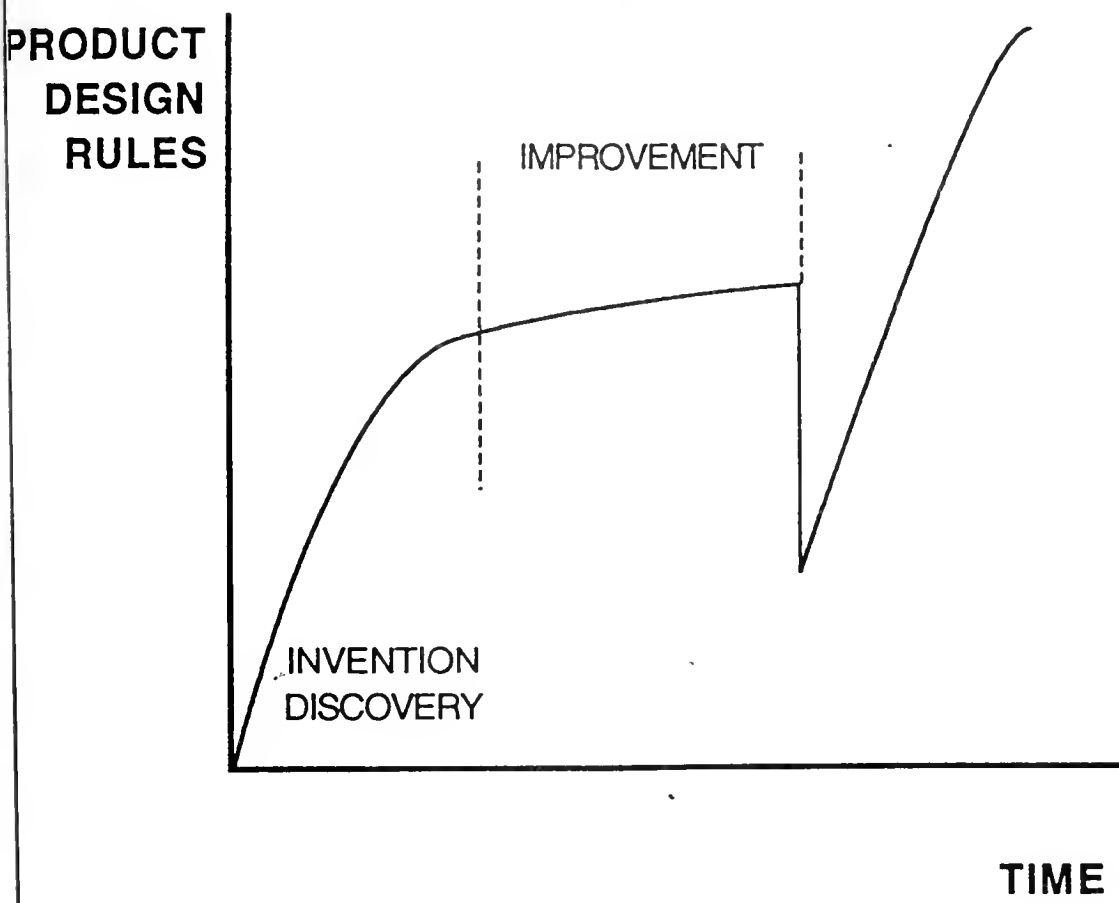
You couldn't get credit for learning outside of a class. Stanford has a huge cable TV graduate program that they offer.

Japan's one of the few places that locks up their ATM machines at 5:00 o'clock when they close the bank, because it's illegal to bank outside of banking hours. And they don't recognize teleconferenced board meetings.

What I'm getting at is that this kind of over-regulation suppresses technology transfer. If you look at, have we over-regulated in the government sector in the federal labs? Yes, relative to the private universities like MIT and Stanford, which have been leading on this. That's what I was getting at earlier when I said that there's an attitude difference.

One other very quick point I wanted to make.

INNOVATION CYCLES



SLIDE 3

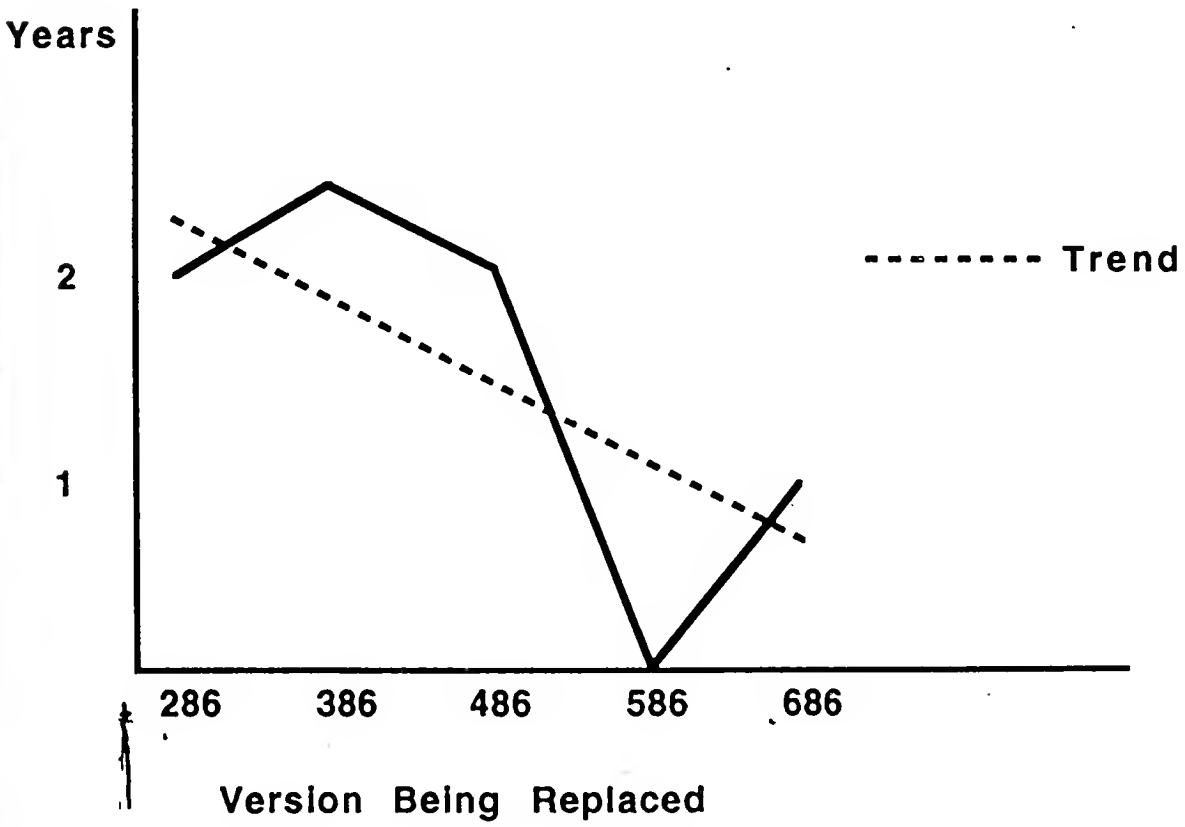
Mr. PRESTON. If you look at innovation cycles, when you create a new invention, you go through a period when it goes through rapid discovery. Like, I invent the transistor here, it goes through rapid discovery and improvement. Then all of a sudden, I start making it incrementally better, changing the size of the transistor to make it smaller and smaller and smaller.

And then someone invents the integrated circuit, kills half the rules for success, and we start it over again.

I would argue that in the U.S., if we shorten the half-life of our products, we can gain enormous competitive global advantage because the U.S. is better at the creative side than any other nation in the world. I would argue that Japan is better at improvement than the U.S. because of cultural reasons.

Let me show you some data that support this. In other words, if you shorten the half-life of a product, you favor the people who are on the creative side.

YEARS FROM VOLUME PRODUCTION TO ANNOUNCEMENT OF NEXT VERSION



SLIDE 4

Mr. PRESTON. Let me show you Intel's data over the last 10 years. This is in essence the half-life of Intel's products. And by the way, the key thing to remember here is that the United States recaptured 20 percent of the worldwide semiconductor market over the last 5 years, totally at the expense of Japan. That's a very unusual situation.

What has Intel done? Intel has, instead of its products lasting two years before they announce a product that makes it obsolete, when they released the 586, they announced at the same time a product that was going to make it obsolete. When they released a 686, they announced one year later that they were releasing the equivalent of a 786. They don't name it that, but you can see that the half-life has been getting much shorter.

The same trend has occurred in the other companies that are showing this kind of strength—Hewlett-Packard, Motorola, and TI. There's a huge incentive to get to the market faster and faster.

Mr. SCHIFF. Thank you for the additional time, and thank you for that explanation.

I yield back, Madam Chairman.

Mrs. MORELLA. Yes, and thank you, Mr. Preston.

I'd like to now recognize Ms. Rivers from Michigan.

[No response.]

Mrs. MORELLA. I'd like to yield to Mr. Gutknecht for any questions you may have.

Mr. GUTKNECHT. Madam Chair, I don't have any questions.

Mrs. MORELLA. Ms. Lofgren?

Ms. LOFGREN. Thank you, Madam Chair.

Just quickly, as we look at the—and I think everyone here is a supporter of the government-industry partnerships that are moving technology forward, and I appreciated Mr. Schiff's line of inquiry about, there are those who disagree.

But as we think about the value of technology in the private sector, and the partnerships that have gone forward, and probably need to be enhanced, I wonder what your thoughts are about the missions of the lab, and how those can be maintained—or should they be maintained—while we expand the technology transfer issues?

And whatever your thoughts might be, each of you, on that subject, it seems to me that mission-driven science has been the most successful. And if I may, I'll just make a short comment about that.

I don't think any of us want to be interpreted as defending the status quo. A lot of these labs came from the 19th century, and certainly since World War II. And we certainly had a different economic and political and military climate.

I certainly would not say that all the missions of the laboratories right now is exactly where they need to go. I think you need to get, as the Galvin Report with DOE and others are doing, get some of the users in and look at what these labs are doing. Are they on target?

I think that's badly overdue. I think we've got a whole new climate right now, and that really has not been done in 50 years.

So I agree with you. I think that's something that's badly needed, and I think coupled with the legislation you've got, then you've got something where the government gets out of the way, gives incen-

tives to the laboratory, lets them experiment, which means they'll make mistakes. And Congress needs to recognize that.

And I think you would then capitalize on what John Preston just said. That's our core strength. Entrepreneurship is our core. When you get away from that, when you put bureaucracy on it, you're playing away from our strength.

And again, if you look at that infrastructure, fine-tune it, shut it down, change it—nothing wrong with looking at it occasionally. But, coupled with the legislation you've got, I think you've really got a winner.

Ms. MCKINLEY. If you look at the technology transfer personnel and function within federal laboratories, historically the personnel in tech transfer offices have been some of the more innovative personnel in the laboratories. They are in a sense internal entrepreneurs.

For many years, they have had to ask forgiveness, because they just didn't feel that they had the time, and they lost the partners if they seek permission. The Federal Lab Consortium with its 600-member labs is in a bit of a difficult spot right now because we recognize that the missions of the laboratories and the agency R&D programs are changing, and need to change as the society changes.

And we are the entities that are to be told how we will change.

We hope that the innovative work that we've been doing in technology transfer will be looked at as areas that are opportunity for growth. We continue to believe that technology transfer offers federal labs opportunities to leverage increasingly scarce resources and still meet the mission needs that are established by our agencies and by Congress.

It is a very interesting and in some respects chaotic time right now to be working at a federal laboratory anywhere in this country. And if you are essentially an aficionada of chaos, in some respects you welcome that and recognize that what comes out of it will probably be better than what the situation looks like right now.

Dr. TEMPLIN. I'd like to offer just a bit of a new twist. And that is that sometimes our federal labs that are mission-driven develop a unique capability which by themselves can't be tapped without further investment, sometimes by the states, and by the private sector, but also in concert with the federal government.

I'll use an example of such a facility in Virginia. The free electron laser—Department of Energy—I mean the continuous electron beam accelerator facility in Newport News, Virginia, has just come online. It has the capability to develop the country's—in fact, the world's first large free electron laser with tremendous commercial potential, if we can demonstrate the feasibility idea.

A consortium of the state, the universities, the federal lab, and the private sector have come together and have put forth a proposal. Of that proposal, over half of it will be funded by the state and by the private sector.

But there's a large block missing that is appropriated to the federal lab to be, as a partner, connected to the continuous electron beam accelerator facility.

The Department of Energy has conducted a review of the project, thinks it's a good idea. But because it is multidisciplinary and

doesn't fit the mission of any one agency, there is no funding source.

Consequently, a unique capacity, not only in the United States, but in the world, to develop a competitive edge in an emerging technology, will be lost, not because of a lack of private support because it is there, or state initiative because it is there, but because of the inability for missions to be flexible enough as the technology changes to take advantage of it.

Consequently, we are now waiting and undecided about how to take advantage of this unique capability, the direct result of a federal laboratory, but unable to capitalize for our competitive advantage.

Mr. PRESTON. I think you really hit the nail on the head, that you have to have mission-oriented research in order to succeed. Again, if I look at Singapore, there are nine national labs, one of the nine supporting hard disk drives, one of the nine for wireless communication, and it goes on. Every one of the nine is industry focused.

None of the 726 national labs in this country are supporting the hard disk drive industry, except to the extent that it's a spinoff of military research.

I'm not saying that the military research activity is bad, and that mission needs to be changed. But I think there is room for us, as Mr. Schiff mentioned earlier, to even the playing field by creating an industrial research competitiveness that rivals what our foreign competitors are doing.

And I would choose areas of importance to the future of this country, like telecommunications, computing, and so on, as areas to focus on.

Ms. LOFGREN. Thank you, Madam Chairperson.

Mrs. MORELLA. Thank you for the line of questioning, too, and the fact that we do have to get at the military and industry and government working together.

I'd now like to recognize Mr. Wamp, who represents Oak Ridge, for any questions he may have.

Mr. WAMP. Thank you, Madam Chairman.

Let me first commend Ms. McKinley for the confidence and the candid spirit that she continues to show with her attitude here, because this is obviously a time of change, and we all know technology transfer is not exempt from that change.

Let me identify myself wholly with the comments of the gentleman from New Mexico with respect to technology transfer, as he exits the room here on me.

I have in my basic education on science, energy, technology issues, and technology transfer specifically—I have come to realize that if we were in a perfect world starting from ground zero, those in this country who believe that technology transfer somehow flirts with socialism or government control of every mechanism in the free market society that we live, interferes somehow with our inalienable rights.

In a perfect world, that argument may be justified. But we are in a situation where we have tremendous equity built up, a federal reservoir of information, science, incredible resources through what

we have built, primarily from defense technology, but now in many other realms as well.

And the question is whether or not we take advantage of it, and stay competitive and use it.

In a perfect situation, again in a vacuum, we could say, "No, we need to move away from this." But I think it would be a terrible waste. But I do think we need to define, as Chairman Schiff is trying to define, exactly where we're going so that the American people will feel like we're in a partnership with them, communicating our assets and our direction all along the way.

I understand that before I was able to come in the room, that we talked about how to gauge the measurements of success in technology transfer. I want to share just from my perspective what I shared with my friends at the Tennessee Valley Authority. Many of you know, I have 6,000 employees of TVA in my district, and so I spend a lot of time on energy issues, with the Department of Energy operations in Oak Ridge, and also the Tennessee Valley Authority.

What I said to my friends at the TVA is: If you want to continue to receive funding for economic development, you need to start measuring your success by the number of jobs you create in the private sector, and not by how many TVA employees are working in the area of economic development.

I would submit to those of our friends in technology transfer that, if we can measure manufacturing jobs created in the private sector as our road to success, and not CRADAs. CRADAs are a critical element. The agreements are essential.

But if we can begin to say to the American taxpayer, "We're talking about your job and your neighbor's job, and we're talking about parlaying our assets to further advance our free market job growth," then technology transfer is going to be successful, versus technology transfer being classified as some quasi-governmental program that is a way to keep our laboratories open, et cetera, et cetera.

You know the arguments. We don't agree with the arguments, and I identify myself with Chairman Schiff, and just offer that as a suggestion.

But that gets me to the question that I have. And that is, where do we draw the line between what the private sector should be responsible for, and what the public sector should be responsible for? And, how do we identify the elements, the manufacturing, technology, that we can just leave to the private sector?

We had last week at the energy mark-up on the science committee—and it carries on this week—the GTMHR, the gas turban modular helium reactor, a big discussion over exactly how far that technology has advanced, and should it be totally in the private sector or the public sector?

The same thing holds true here. We're trying to determine, where's the line? What's the private sector going to carry? What about other nations, Japan, Germany, where the role of the federal government is more proactive, maybe, than we have here? And how do we determine exactly what we should leave to the private sector?

Anyone?

Ms. MCKINLEY. I'm sorry, Congressman Wamp. I think the questions are only going to get tougher.

I think that, as we take the interface between public R&D and the private community, that it is only going to get less and less clear on a standardized basis what the role of each is going to be. As you've pointed out, it's a function of the technology. It's a function of the government need. It's a function of the private sector need. It's a function of the development of manufacturing needs of the given technology.

And so I would suggest to you, sir, that perhaps what we need to be doing, rather than trying to focus on boundaries that we can draw, is focus on the questions that need to be asked for a given situation, so that if we're asking consistent questions, then, based on what the answers are, we can determine what the most appropriate role should be for the federal laboratory, if you will, and perhaps the private partner.

And it may very well not be the same from case to case. But if we're asking the same questions and we're making defendable decisions, and they appear to be sound decisions, that maybe is the best we can do.

Mr. WAMP. Mr. Allen?

Mr. ALLEN. Actually I agree with Tina. I think it's almost an impossible assignment, because government does mission. The Defense Department does mission. It does applied research. So you're never going to have—and we can all agree. I think basic research is something the government should do, and applied is something generally you can't do.

But when you look at the spectrum, having said that, it's all over the place. And the technologies are moving so quickly that, basic and applied, the line is not making as much sense as it did 40 or 50 years ago. And as John really pointed out, a key point to really be competitive, you've got to get industry in there taking the stuff out right now, which means you're blurring those lines all over the place.

And I think you're going to find that continuing. And again, you're going to have states coming in now looking for economic development. So the speed of technology is going so quickly now, I would really be amazed if you ever find a time when Congress just has a litmus test and says, "This is our thing for investing $75 billion of research," and it's all on this side or that side. I don't think that's the world anymore.

Mr. PRESTON. I think one thing you could consider doing is looking at what is matching industrial expenditures in an industry, and how is it shifting as a function of time?

In other words, is the government really seeding something that's going to yield fruit? You know, putting this in the Singapore perspective, when Singapore starts a new laboratory, they say, "Okay, initially we're willing to spend 90 percent of the money on research spent by the industry in Singapore. But we'd like to see that shift and become 10 percent in 10 years."

If you start seeing huge investments growing in this area from the private sector, it's saying you've really done something wonderful.

I'm founder of Molten Metal Technology, which is heavily involved in Oak Ridge. And we've taken advantage of collaborations, CRADAs, with the laboratory there, to take a really pernicious problem of nuclear waste, where we've taken a ton of nuclear waste, and we give back a wine glass to the utilities who generated it, in a much more stable form.

And I guarantee you that that technology commercialization could have not occurred without the ease of the assistance with the laboratories. And picking on the expertise, that company is now the number one growth company in the world in the environmental field.

This is a blurred line. You need to look at, does an investment made by the government stimulate a much larger investment over time by the private sector?

I think in the environmental field, we've seen good evidence that it's happening.

Mr. WAMP. Shifting gears quickly, if I could, Madam Chairman.

From your perspectives individually, what do you think the consequences would be for our ability to transfer technology from the public sector to the private sector if my friend Tiahrt's proposal to eliminate the Department of Energy prevailed?

I don't agree with that, by the way, but I'm just asking you a real tough question.

[Laughter.]

Mr. ALLEN. Who wants to start with that one?

Mr. SCHIFF. It's okay. We're all Republicans fighting among ourselves, so you can take a choice here.

Mr. ALLEN. Well, I'm from West Virginia, so I probably don't know any better. I really don't know. I think the real question is, what do you do with the facilities? And again, I really am not that familiar with the concept. But I thought we were going to move some things to the Defense Department.

One of the problems you run into is, if you're not really reducing the budget, and you're just sort of moving things to make a more sensible alignment, which I don't know if that is or is not the purpose, there are procedures now at DOE, and DOE has taken 20 painful years to start sorting them out. They are certainly nowhere where they should be, but they're getting closer.

I think what you're going to find it, as far as the speed and certainty of getting those collaborations, that that's going to go out the window, and you're going to start over again.

So I think the question you all need to look at is, from a budgetary perspective, or an authority's perspective that makes sense, that's one thing. I think as far as tech transfer goes, I really don't see it as a positive, unless you're just going to get rid of the facilities, which, as I would say, is a major negative.

Ms. MCKINLEY. I have to in some respects take off my Federal Lab Consortium hat and put on my hat as an associate division director with the Oak Ridge Institute for Science and Education, which is a Department of Energy laboratory. And I have to concur in the points that Joe has made, and certainly Secretary O'Leary has made as well.

That is, if what we're really talking about here is changing the letterhead and realigning some things, that the government will

need to continue to manage, in the process wiping out perhaps some very viable research, and losing some substantial resources that, as you pointed out, Congressman, have been carefully built over a series of decades.

In the long run, that could be a very real loss, and perhaps a costly move to make. Certainly the Federal Laboratory Consortium will represent the entire federal laboratory and agency community, and we will continue to represent whatever changes may develop in that community.

But at this point in time, the FLC does not have a position on any particular agency changes.

Mr. WAMP. Madam Chairwoman, I told you the people in Oak Ridge were very bright. [Laughter.]

Mrs. MORELLA. No doubt about that.

I think the other two panelists probably agree with the statements that have been made by the initial two. It's been a very exciting panel. You haven't left yet, because we have a few more questions.

I'm just going to ask my colleagues if they will recognize the fact that we've got two more panels, and thank them very much for being so patient, starting off with Mr. McHale. Thanks for your patience.

Mr. MCHALE. Thank you, Madam Chair.

Madam Chair, I noticed you always ask for brevity just as I begin my questioning. [Laughter.]

Mr. MCHALE. She has heard my questioning on other occasions.

Mrs. MORELLA. We're not talking about the MEP program at this point.

Mr. MCHALE. I actually have only one question. It follows up on what Mr. Preston commented upon a few moments ago, and that is the need for effective seeding. That is, not only to have good intentions, but to have demonstrable proof that a federal investment ultimately ends up in enhanced job opportunities and employment in the private sector.

I represent a district in the State of Pennsylvania. For the past dozen years, we have had the Ben Franklin Partnership. For half that period of time, we have had the Manufacturer's Resource Center.

So my question to all the panelists would be this: Where we have ongoing state-based programs with proven track records of effective seeding—that is, investment of public dollars—having brought back in return on that investment proven job opportunities in the private sector, how can we at the federal level craft legislation that builds upon and reinforces those existing state-based success stories?

Mr. Preston, it was your comment that led to my question. We'll start with you.

Mr. PRESTON. I think there are a number of things that could be done at the federal level. One is to increase the differential. I'm now going to financial, because you're talking about this from a financial point of view.

But if you increase the differential between short-term capital gains tax and long-term capital gains, you can do it in a neutral way. You increase short-term or lower long-term or do both.

That will have some of the net effect of driving private sector money into supporting the types of investment that the Ben Franklin Fund has been doing so marvelously well over the last 10 years.

You may want to also consider having some federal matching support. Recently, for example, the Small Business Innovative Research Grant Program in the Department of Defense made a change imparted at my urging to say that they would speed up the Phase IIs and they would give priority to Phase II awards, which can be $500 to $1,000 to $1 million, if there was a matching private sector investment, sort of as a way to reward the fact that that technology really did have commercial viability as proven by a venture capitalist like the Ben Franklin Fund, willing to put money down to support it.

So I think you're hitting a very key point, and I support the direction you're going, and I would do it either through tax incentives, even neutral ones that shift money away from legalized gambling, like buying derivatives, and toward investing and generating wealth and jobs in this country long-term.

Mr. ALLEN. If I could give you a slightly different answer. Actually, we're in Wheeling, West Virginia. We work very closely with the Ben Franklin Center, particularly in Pittsburgh.

What I would urge you on a slightly different track is, pass Mrs. Morella's bill. Make sure the laboratories have the ability to work with states. Get the bureaucracy out of the way, and I think you'll be amazed at what happens, because these state programs, very much like CIT, know the local industry more than the feds do.

And they are the people that we go to say, "Who in this region, particularly small companies which get left out a lot of the time when we're making big decisions in Washington? They know those people. They can match them up.

Again, what I would urge is, pass Mrs. Morella's bill. Watch the bureaucracy. Don't let them recentralize. Don't get a lot of processes, master agreements, all the stuff they love to put on top.

Simply get the authorities down. Implement the law. Let the states go to it, and I think you would see us blowing the other people out of the water.

Mr. MCHALE. You've twice urged me to vote for Connie's bill. I can only do it once.

Doctor?

Ms. MCKINLEY. One of the things that we've watched over the last decade or two—and it's been fascinating to watch—is the recognition the federal laboratories may be federal laboratories, but they're located in states and regions.

The fact is the technology transfer, like politics, is local. It's a team sport. Mr. Preston may be the founder of Molten Metals, but at the moment the venue at Oak Ridge is the beneficiary.

So we find that there is an increasing awareness that the federal laboratories that are within state and regional boundaries are tremendous regional and state resources. And there's a growing awareness on the part of the federal laboratory managers and the state people as well that these resources need to be used more effectively. And that is happening.

Congresswoman Morella's bill will certainly support this. And the FLC hopes that it does pass. And we find, as we look at the

history of interactions at our regional level, and between our federal labs and our states, that there is an increasing willingness to work together. I think it's very positive at the present time.

Mr. MCHALE. Dr. Templin?

Dr. TEMPLIN. Since we're in Virginia, part of creating the partnerships between the labs and universities and the private sector all echo the incentives that are provided in Chairwoman Morella's bill.

But in addition to that, what we've learned from the university environment is that the climate itself, the incentives to change the climate of the laboratory wherever that can occur, to reward entrepreneurialism where it is there, to make it easy for laboratories to collaborate between themselves and consortia of universities, that requires a delegation of authority to the lab itself.

Here we have federal labs that are responsible for half a billion or more in federal dollars and expenditures, and yet get tied up in six-month agreements of half a million dollars or less. We need the authority at the local lab level to enter into the agreement, and to sign off, to provide a responsive market driven orientation. That's what business desires.

And that it not be limited just to CRADAs, but technical assistance is where the majority of our work is. To create an environment that rewards laboratory personnel facilities and the use of technical assistance. Those are the lessons we've learned in the universities and in the states. And we're asking our partners at the federal labs to join us in that spirit.

Mr. MCHALE. I appreciate all of your comments. The national labs are obviously vitally important. My purpose in raising this line of questioning in the form of one question was simply to emphasize that the states have done some wonderfully innovative work where there are quantifiable results after a dedicated purpose.

And it would seem to me that one thing we ought to examine is a concentrated federal effort to reinforce those success stories. Obviously we've got to be creative. Obviously we've got to reach out in new ways for potential job-generating activities, utilizing the federal labs.

But where we have state-based programs with proven track records, it seems to me we want to build upon those success stories.

Madam Chair, thank you.

Mrs. MORELLA. Thank you, Mr. McHale. Thank you for asking that question, too, because we've gotten a nice affirmation of the bill that you've tried to vote on twice.

Mr. MCHALE. I asked the question exactly as you phrased it. [Laughter.]

Mrs. MORELLA. Speaking of the Ben Franklin program, Montgomery County, Maryland, has emulated it, and is in fact using a key person, Will Placella, who was with Ben Franklin, who then went on now to North Carolina.

Now it gives me great pleasure to recognize Mr. Baker, who represents the Lawrence Livermore National Laboratory.

Mr. BAKER. Thank you very much, Madam Chairman.

We all are in agreement that tech transfer is necessary. We also agree the bureaucracy and delay of licensing and proceeding on re-

search is a problem, but are not adequately funding tech transfer this year because of the pressure on the budgets.

So if you were to dream with me for just a minute. We've heard about the Singapore response—rush out and then have a government research project for every problem we can find. Those days are over. It's not going to happen.

The reason Japan is in such soup, as we showed on the screen, is because they don't allow new innovations into their country unless they invent them.

So the Soviet Union invented the automobile in 1950. We all heard about that. They paid eight times the world market price in Japan for rice. They won't allow our chips in. They caused their own problem.

We have a free market. So our problem's going to be different. We can't respond fast enough to advances of other innovators around the world, unless we get our act together.

So here's what I'm asking you to dream about. Suppose we only allowed tech transfer when the companies will allow us to be the final beneficiaries along with them. If our licensing agreement allowed our investment, be it as small as one-half of one percent, to become part, either through stock or through that specific program, then they would only come to us when they had a need, when we either had superior knowledge, superior equipment to test things on, or secrets that have been locked up through the military that they could put out in the private sector.

And there would be some lack of inertia. They would be moving fast to get to the marketplace. And we would then benefit and be able to spend more next year on technology than we did this year.

Can anyone think of this as an addition to the Morella bill, or is it covered by the Morella bill? And I'll give you one last example and ask for your response.

We're now trying to invent a hydrogen fuel, and we're questioning whether it's going to need a fuel cell, or will it work without a fuel cell, or will hydrogen be the product without pollution in the end?

The only way to do that is the way we went to the moon—put a crash program on and say, "I'm sorry. We want to beat Japan. We want to beat Germany. We want to get to the marketplace first. And we're going to be your partner. We're going to be willing to put up x number of millions of dollars, and we're going to be ownership of x percentage of that project when it goes to market."

Will it work? Is there a way we can, instead of mouthing the terms that we're for the marketplace, actually let the marketplace dictate our research?

Mr. PRESTON. Shall I start? I think you're raising some interesting points. A lot of them were already covered in the proposed legislation.

In other words, the ability to license and to collect royalties and to use those royalties for government purposes, in addition to creating an incentive for the individuals who are the inventors of that technology.

I think going much beyond where we are right now raises some risks, because if you were to say, "Let's mandate that every deal done with the U.S. government involves a royalty coming back that

can be used for government purposes," some companies, you know, like in the case of Molten Metal, came to the government already with the core technology, and the relationship was one of improving a core technology.

You could say, "What's been the benefit to the U.S.?" You've got a five-year-old company that's created 250 jobs in the U.S., and is growing rapidly. And that's not counting its half-dozen partners that have created more jobs. And those guys pay taxes, and you get the multiplier effect that way.

I think, to the extent your idea is applied reasonably by the licensing offices within the government and within universities, it's a great idea, and is indeed already covered under the Morella bill.

Mr. BAKER. Let me use SEMATECH as an example. They went through a private consortium, public consortium, and then back to private. The main benefit to me seems to be the new collaboration was allowed under the federal laws that disallow people from working together.

So they got rid of that restraintive trade problem, and were able to do a job. But it didn't have to be done by the government. If they felt they needed us, then we could have become a partner.

I'm looking for a way to enhance our being a part of the act. You mentioned there was some 3,000 CRADAs or some figures when you started, Mr. Allen, and Ms. McKinley. How many of those had licensing agreements, or how many of them are just depending on us for being good old Uncle Sugar?

Mr. ALLEN. I think that would be a good metric, as we were talking about earlier. Because, if the game becomes counting CRADAs, then you can turn everything into a CRADA, the bureaucracy response to what Congress is counting, what the administration is counting.

So I can't answer that. But actually, the Commerce Department has a report to Congress every year where they just start giving those numbers. And I think that would be a thing to track.

The other issue you raised, which I don't have an answer to, is now that U.S. industry is reaching out to the lab system, if you had this hearing 15 years ago, you would have a hard time finding many companies to say that there's any value.

Industry is reaching out now. The Industrial Research Institute Survey finds their companies are factoring in universities and federal labs as part of industry's strategic design. At that same time, we're cutting back in real terms on the staff that actually make these deals go.

So there's a mixed message being sent to the laboratories. We hear how important it is, but there's less people there. The experienced people are leaving. There's no rewards for the individuals putting the deals together, which I mentioned in my testimony.

I think you're hitting on the things now where Congress needs to look at this, and put some real capitalistic incentives in, meaning money going back somewhere, for success. As you look at the missions of the laboratory, we mentioned with Mrs. Lofgren, Congress needs to make sure the rewards go back to the people that are doing the activities that you specified.

And I think that's the biggest incentive you'll have for the federal system, just like in Watergate, to go where the money is. And

that's what people respond to. This is a capitalistic system, and I think people are looking for what your deeds are, in addition to the words they hear from Washington.

Ms. MCKINLEY. I concur with what both Joe and John have said. I would also remind us again of what we talked about several times in the last hour or so. That is the importance of technical assistance and the expertise that's resident in the federal laboratories that does not always manifest itself through a licensing agreement.

What Chairwoman Morella's proposed bill does is to increase the options that are available to the laboratories so that each situation, perhaps, has additional options that it may not have had quite as strongly before.

But we also recognize that if you look at the 3,500 CRADAs that are currently operative in the entire federal community, they don't all include licensing arrangements, because there are cooperative agreements that are there solely to tap into expertise. And hopefully as an outcome, there can be something for which a licensing arrangement can be developed.

So I would suggest, sir, that we have to recognize that every situation is different in some respects.

Mr. BAKER. I'm hoping to use the licensing agreement as the screen so that those people who really need us will come to us, because I'm sitting here watching the tech transfer expenditures wither. As we're sitting here talking about how important they are, the real numbers in the budget are dying. So we've got to give a new shot of life.

And I think the answer is to find some programs that are extremely healthy, like perhaps hydrogen fuel, and let them rip, and bring us the proceeds, and show the people, especially on the budget committees, that not only do we have secrets that can become very commercial, but that through our scientists and our laboratories, we can hone them to a point where they become terribly profitable.

Otherwise, we're going to watch the downsizing. One of our colleagues has already introduced the Lab Closure Bill. And I'd like to see that die a healthy death, because we'll have a new vision and a new mission for the labs.

But it has to be based on free market, and not just on talking about it, but actually doing it. And whether you count CRADAs or cooperative agreements, or however you define them, I'll bet five percent of these projects are not licensed.

Mrs. MORELLA. Thank you, Mr. Baker.

You've heard about the next person who's going to testify. Now you're going to hear from him.

Mr. Tiahrt.

Mr. TIAHRT. Thank you, Madam Chairman.

I wouldn't want anyone to make a decision without full knowledge about what's being proposed. So just as an opening statement, I want to talk about the bill that we have pending that will eliminate the Department of Energy as a cabinet level position.

A portion of that will be the Energy Laboratories Facilities Commission, which would follow on the work that Mr. Galvin carried out. And I'm sure you're familiar with his reports on the nine major labs.

The Department of Energy has approximately 30 labs. What we have proposed is a seven-member panel that would be made up of people who have expertise in research and development, and basic research, and applied research.

Two would be appointed by President—I mean Majority Leader Dole—excuse me. The other two would be appointed by the speaker of the House. And then three, by President Clinton, with him selecting the chairman of the committee.

They would then do a search. We've often likened it to a BRAC-like commission. But I don't think that's really a good analogy because everybody associates the BRAC Commission with base closure. That's not the intent, necessarily.

The intent of this Energy Laboratories Facilities Commission is to look at the facilities, their capabilities, to look at what kind of cost/benefit analysis the current research and development that's going through those labs is providing, looking at the mission, doing some type of a mission analysis, impact of revenue sharing.

Sometimes there is actually revenue generated by these labs, and that impacts the cost line.

There's a 12-point criteria, and I don't recall all of them right now. But there's a comprehensive review of the Department of Energy labs, and some have argued that it should be to all government labs, it should be expanded to all government labs, because what we're after is a way of effectively spending the taxpayer's dollar, so that we're not wasting it through duplicative missions, through having research that's going on in an incoherent manner.

I think that the labs that are doing a very good job now, that have been the most effective, have the most to gain. The multi-purpose labs probably have the most to gain because of the broadness of mission. And those labs that are run ineffectively, have a lot of overhead, that are not doing a good job of spending the taxpayers' dollars probably have the most at risk in this proposal that we have before us.

So my question would be, in light of what Dr. Galvin has written—I keep saying Dr. Galvin. I don't know if he's got a Ph.D. But Bob Galvin, who I met with—I didn't ask him. I guess I probably should have asked, then I would have known.

He's somewhat frustrated that his proposals haven't been carried out. He did put an awful lot of work into it, and I like what I've read in his report.

But in light of that, what impact, if we implemented a similar Galvin-type corporate management style for the labs, how would that affect laboratories, number one; and the way you view technology transfer, number two?

I would open it up. I suppose those of you who are directly involved with the labs may want to respond.

Ms. McKinley. I think it gets back to the issue of laboratory missions, and who assigns the missions, and where they come from.

Joe mentioned earlier the possibility from the perspective of technology transfer of potentially being able to bundle common technologies across various agency R&D missions. As I understand the Galvin Report, that certainly is the intent for the laboratory operations board, to take a look across all of the DOE labs.

I would also suggest that the gentlemen who are on the panel following this one are perhaps far better qualified to answer this question than those of us at this table. But I think that in many respects, as far as the Federal Laboratory Consortium is concerned, that our posture would be to follow the directions that are provided to us by our member agencies and by members of Congress and to work together to try to continue to transfer technology as effectively as we know how.

Mr. SCHIFF. Would the gentleman yield for just one second, please?

Mr. TIAHRT. Yes.

Mr. SCHIFF. I appreciate that. I just want to say that I'm drafting legislation which will be circulated among all the members of the Science Committee to try to define the missions of the Department of Energy laboratories in the post-Cold War world.

I think whatever one's view is as to where the laboratories should go, the absence of a clearly defined mission is clearly frustrating to everyone. I'm going to try to help solve that problem.

I thank the gentleman for yielding.

Mr. TIAHRT. I think part of this process that Mr. Galvin referred to, and this corporate style of management, will be directly related to missions, what missions would be pursued, what types of research and development would continue in that lab, and his efforts were to streamline the decision making process, which I think would be more effective for all research and development.

And I think that this self-evaluation that each of these labs would go through in writing their mission statement, for in my case, the Energy Laboratory Facility Commission would be effective in helping determine how they could best serve this country.

By the way, I think they've done a fine job. I think that's been misinterpreted.

Thank you for your indulgence, Madam Chairman.

Mrs. MORELLA. Thank you, Mr. Tiahrt. You can see, everybody is most interested in the fact that we do need to have a mission.

Before I adjourn this wonderful panel that we've had before us for awhile, I just want to ask one question of Mr. Preston, because it pertains to your dealing with government technology agencies, such as NIST and DOE.

Do you find that universities and nonprofit participants in joint research and development projects are treated on a par with the private sector profit-oriented entities? Do they have an equal voice and involvement?

Mr. PRESTON. That's a good question. The answer is, not really, and especially under some programs, the ATP, the Advanced Technology Program and NIST use universities differently that have used for-profit companies.

They have interpreted the legislation that enabled ATP to mean that intellectual property must go to a for-profit. The net impact of that interpretation of the legislation, which in my opinion violates Bayh-Dole is that the best researchers at U.S. universities are isolated from participating in ATP research, which I think is a problem, because I think NIST has alienated some of the most creative minds to provide ideas that could be commercialized.

So I think there is a difference in the way that U.S. companies are treated, where for-profits are treated differently. And I think the U.S. suffers from that, because universities, if they did take title, would end up licensing it to the U.S. companies who would insist that those companies use the technology, or the license reverts back and can be given to another U.S. company to utilize it.

And there's a third problem, which is that universities are funded through tax exempt bonds, and the tax exempt bonds prohibit the universities from assigning title for any work done in those facilities.

So we have a legal contradiction. Under one law, we cannot take the ATP money and fulfill the requirements that ATP is putting on us. So we really are in a quandary there. And I would strongly support amending the ATP legislation to recognize Bayh-Dole. I think Bayh-Dole can be proven very clearly to have been useful to this country, and we could go through lots of metrics to support that. And universities are using it wisely.

Thank you for raising that question.

Mr. ALLEN. If I could just add one thing to that. I strongly support your language on amending the ATP program, but I'm getting into the philosophy of advanced technology programs to have Washington make a decision that universities cannot own their own technology if they bring it to ATP. It's counter to everything we've talked about for the last hour and a half.

I think it's bad law, it's bad policy. It gets away from our competitive strength. And I really would urge the subcommittee, as they mark up the bill, to support Mrs. Morella's amendment, because that, again, is the market-driven way of doing it. You don't need Washington getting involved in it. To me, it's a solution seeking a problem.

Mrs. MORELLA. I want to thank the panel very, very much, for the expertise that they brought to this hearing. You could tell from the members' questions, more could be asked of their interest.

We might want to send questions to you that we didn't have a chance to ask. And we're going to reconvene after the vote. I'm going to return now for the vote for about 10 minutes before the second panel.

Thank you very much.

[Recess.]

Mr. SCHIFF. I'm going to reconvene the subcommittee joint hearing at this time, and invite the second panel of witnesses to please come to the table.

On behalf of the Congresswoman and myself, I'd like to welcome here Mr. Richard Marczewski, Manager of Technology Transfer Office of the National Renewable Energy Laboratory. And I apologize. Did I pronounce your name correctly?

Mr. MARCZEWSKI. It's pronounced Marczewski.

Mr. SCHIFF. Right after I said it, I knew I'd made an error.

Mr. MARCZEWSKI. It's a Polish extraction.

Mr. SCHIFF. Ambassador C. Paul Robinson, Vice President of Laboratory Development at Sandia Laboratory. Now, where is that, Albuquerque, New Mexico? (Laughter.)

Mr. William Martin, Vice President, Office of Technology Transfer at Lockheed-Martin Energy Systems at Oak Ridge National

Laboratory; Dr. Peter Lyons, Director of the Industrial Partnership Office at the Los Alamos National Laboratory; and Mr. Ronald Cochran, the Laboratory Executive Officer of the Lawrence Livermore Laboratory.

Gentlemen, we welcome you all to the Subcommittee hearing. You've heard the bells and whistles for votes, and you know that the members have had to go back and forth. And I think all of you are veterans of doing this.

And so, let me say again that there is no intention to be rude to you as witnesses, or any other witnesses. Just a number of things happen in Congress simultaneously. Again, that's why a record is made of hearings, and why it's ultimately distributed, and why there's a number of staff of members sitting behind you right now taking notes for the members who aren't able to be here.

With that in mind, I'm going to say that, without objection, all of your written statements will be made a part of this hearing.

I will ask you to proceed, and try to proceed with a five-minute summary each so we can hear this panel, and a third panel we have scheduled.

Ambassador Robinson, I'll start with you if that's okay.

STATEMENT OF AMBASSADOR C. PAUL ROBINSON, VICE PRESIDENT, LABORATORY DEVELOPMENT, SANDIA NATIONAL LABORATORY

Ambassador ROBINSON. Thank you very much, Congressman Schiff.

I think the questions that you're facing on the futures of technology transfer are among the most vital questions for the country, and not only just for the laboratories. I think the laboratories fulfill a unique niche among the other research providers in being the most successful multi-discipline problem solvers in the country.

We believe that's the principal value that industry has been seeking from us, and I think the return is beginning to show. The industry demand has been very high. Our laboratory has been over-subscribed, about eight to one, from industrial customers who would like to participate and join in these technology partnerships.

Some of the metrics that were discussed in the last session, we have been employing, including metrics of customer satisfaction. And indeed, I think we've moved from the level of measuring activity to the level of measuring results. And in the testimony, there are a number of results quoted from our CRADA activity, as well as some of our large partnerships.

I applaud very much the focus on streamlining processes. We've worked hard to try and improve within the rules we've had. But I think the rules are still more cumbersome than meeting industry on their own terms. And whatever can be done to simplify those processes, we would like to see simplified.

Let me just add some new areas of emphasis, which I think will help solve some of the problems that individuals have brought up. We're putting much more emphasis on working with consortia of U.S. companies. In this regard, there's very little of the question of, is this a government giveaway?

This is a participation in which the industry people build technology road maps to decide where their long-term future best lies

in the use of technology. We in the laboratories do the same thing with plans for our programs. And we look where those plans can be inter-knitted together, and where leverage can be derived from.

The other two areas are user facilities over the past year. We've made available 20 major facilities for use by industrial partners. I think that's an area that strikes at the heart of the capital problem.

In the government we don't supply capital. But the years that it takes to build up a facility within the laboratories, if you make that facility available to industry, you shorten the time clocks for trying out ideas, and for getting products perfected to market. And I think it's a bigger help in technology maturation than any other idea.

Finally, the area of technology assistance to small and medium sized business has gotten enough statistics behind it of real results and a large volume of letters of folks that say, "Gee, just one idea from your folks has saved our company." Those are very important for looking at the number of jobs created with new companies, and jobs sustained over time.

I think that area is one of the best success stories and needs to be expanded. With that, let me stop, sir.

[The prepared statement of Mr. Narath follows:]

Statement of Albert Narath, Director
Sandia National Laboratories

United States House of Representatives
Committee on Science

Subcommittee on Technology
and
Subcommittee on Basic Research

Joint Hearing on Technology Transfer
June 27, 1995

Sandia National Laboratories

". . . exceptional service in the national interest"

A Multiprogram Laboratory of the U.S. Department of Energy

Statement of Albert Narath, Director
Sandia National Laboratories

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Introduction

Chairwoman Morella, Chairman Schiff, and distinguished members of the subcommittees, I am Al Narath, director of Sandia National Laboratories, a multiprogram laboratory of the Department of Energy (DOE). Sandia National Laboratories is managed by Sandia Corporation, a Lockheed Martin Company, and performs scientific and engineering research and technology development in support of DOE's missions in defense, energy, environment, and the basic sciences.

I welcome this opportunity to share with you my views on the general topic of technology transfer. A wide range of opinion exists concerning the appropriate role of technical collaboration between federal R&D institutions and the private sector. The proposed legislation will make substantial progress toward clarifying that role. (Detailed comments on the draft Technology Transfer Improvements Act are included in an appendix to this statement.) It is important that the Congress articulate a clear and sustainable concept of technology transfer that the federal laboratories and industry can rely on.

In this statement I will also tell you how technology transfer is working at Sandia. Of all the federal laboratories, we have perhaps the largest and most diverse portfolio of cooperative work. Since 1991 over two hundred cooperative agreements between Sandia and industry have been approved, with a total value in excess of $650 million. More than half of this total amount has been paid or pledged by industry. The Laboratories' core competencies have been strengthened and our capabilities enhanced by interaction with industrial researchers and engineers in technical areas of common interest. This interaction has contributed directly to accomplishing DOE missions by permitting us to cultivate relationships with important industrial suppliers and contributors, explore technical frontiers with those who have a common interest, and maintain critical technical competencies at world-class levels during a period of reduced federal investment.

Contributing to national industrial competitiveness has for some time been identified by the Congress as an important activity of the national laboratories, beginning with the Stevenson-Wydler and Bayh-Dole acts of 1980 and later with the Technology Transfer Acts of 1986 and 1989. But in recent years it has also become quite clear that collaboration with industry is essential to the long-term success of DOE as it reconfigures its nuclear weapons complex and pursues its energy, environmental, and basic-science responsibilities. There should be no misunderstanding that such interaction is essential to the national laboratories' ability to

accomplish their missions. It is, in my view, an important derivative of our core DOE missions. This view of technology transfer is endorsed by the Galvin task force report.[1]

What is Technology Transfer?

The term "technology transfer" is an unfortunate title. It implies that federally developed technologies are warehoused in the national laboratories and that they can simply be handed to industry for commercialization. This literal image of technology transfer is applicable to a very small fraction of the laboratories' relationships with industry, almost exclusively with small businesses. For the vast majority of technical interactions with large and medium-sized companies, technology transfer occurs as collaborative work on problems of mutual interest, and it frequently leads to solutions that neither partner could have achieved independently.

The payoff for joint technical collaboration is mutual benefit. Industry is often able to advance its commercial products based on the results of collaborative work; but just as frequently, the federal laboratory is able to advance its mission capabilities based on those same results.

The recent report on *Alternative Futures for the Department of Energy National Laboratories* (the Galvin report) strongly supports laboratory-industry collaboration when it is related to capabilities required for DOE mission work:

> *For firms and industries that are contributing to DOE's traditional mission objectives, the national laboratories have a useful role in carrying out long-term research and development with potential commercial applications. Indeed, it is even possible to imagine the laboratories playing a role with respect to these industries comparable to that which used to be played by central corporate research laboratories.* (pp. 47–48)

This comment alludes to an unfortunate trend in corporate research and development. Industry's ability to conduct long-range R&D is declining. Even though U.S. companies acknowledge the need to be more competitive in world markets, the trend during the last ten years or so has been to reduce the size of corporate research laboratories. Some companies have transferred their research assets to their business units in order to focus on nearer-term payoffs; others have abolished their central R&D functions outright.

One underlying reason for this trend is that the benefit-to-cost ratio from corporate laboratories has frequently fallen below expectations. We have all heard stories of corporate research labs losing touch with the product divisions of a company, as well as stories where a promising research result attracts no interest from a company's product divisions. Often, a company sells such results to other firms for commercialization (the quartz watch is an example). Rather than do their own R&D, companies increasingly spend more time looking on the outside for technologies that can be purchased and put to immediate use in new products and processes.

Although I do not quite agree that the national laboratories can fill the niche previously performed by corporate R&D labs, they can and should supplement and enhance industry's efforts when such work is also germane to the mission-related needs of the sponsoring agency. I believe that our recent experience with cooperative R&D involving industry and national

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[1] "Alternative Futures for the Department of Energy National Laboratories," Secretary of Energy Advisory Board, February 1995, pp. 6, 48.

laboratories working together has demonstrated a powerful tool for sustaining the vitality of industrial R&D.

Collaborative R&D Should Be For Mission-Related Technologies

In the years since passage of the National Competitiveness Technology Transfer Act of 1989, DOE and its GOCO laboratories have improved their policies and procedures for selecting cooperative work. In a sense, the first few years were exploratory. Policies had to be developed and procedures established as Department attorneys worked to implement CRADA standards and guidelines. We made some mistakes. Industry gave us negative as well as positive feedback. We then began to put more emphasis on building relationships with industry in areas that support the core technical requirements for DOE missions.

From a DOE perspective, decisions to develop industrial relationships have increasingly emphasized collaborative work that advances mission-supporting technical needs and capabilities. For evaluating the appropriateness of collaborative work, the correct criterion is whether the technology being investigated falls within or outside the core technical requirements for DOE missions. Consequently, DOE laboratories may frequently collaborate with companies whose product lines are far removed from DOE's responsibilities but whose supporting technologies are congruent with those required for DOE missions.

For example, tires, as end-products, have little in common with nuclear weapons. However, the engineering and industrial processes employed by the tire industry intersect the set of engineering and industrial processes required for DOE missions. Some structural mechanics challenges are common to both tire design and the design of certain nuclear-weapon components and should be an appropriate field for collaborative R&D.

In fact, Sandia has been collaborating with Goodyear Tire and Rubber Company on such a problem. The company has benefited from access to modeling and simulation codes and experimental techniques developed in the nuclear-weapons program; DOE has benefited from substantial improvements in those codes resulting from the industrial interaction. The improved computer codes will be used to solve weapon component design problems that previously could not be accomplished.

A similar example is Sandia's collaborative work with the University of New Mexico medical school to develop a non-invasive blood glucose sensor for diabetics. While biomedical products and devices clearly fall outside DOE's traditional mission areas, some of the enabling technologies for biomedical devices are strongly represented in DOE missions. Infrared spectroscopy and statistical techniques for processing spectral data are essential skills for DOE work. They are required for the study of gas evolution within solids and combustion phenomena that are encountered in the nuclear-weapons program and several energy and environmental programs. These skills, resident at the Laboratories, made development of the glucose sensor possible. Sandia is not involved in the commercialization of the device, which is being pursued by a private firm.

Sandia's industrial competitiveness activities rest upon a firm policy foundation and are focused on explicitly defined strategic initiatives. The policy foundation is laid out in our strategic plan. The policy is to seek strategic alliances with industry, universities, and other laboratories to pursue research objectives that are mutually beneficial to the sponsoring DOE program and the industrial partner. Such alliances benefit Sandia by permitting us to incorporate the most current commercial technologies into DOE products. They also benefit industry by

enabling the development of new or improved products and services based on access to world-class technical resources. Sandia's core competencies provide the unifying points of focus for our collaborative work. I believe this policy is consistent with the recommendations of the Galvin Task Force.

How Government Programs Benefit from Collaboration with Industry

Benefits to DOE programs from collaborative research with industry can be classified in at least three ways:

1. DOE responsibilities in defense, energy, or environment coincide with private sector interests.

In these cases, the DOE programs can benefit substantially from working cooperatively with industry as a result of the leverage provided by industry's in-kind contributions to the project, the cost-free access to specific industrial capabilities, the expanded reliability that results from industrial testing of components or materials, and the development and maintenance of commercial suppliers for defense programs product needs.

One technical area that fits in this category is environmentally conscious manufacturing (ECM). Our cooperative R&D projects in ECM involve co-development of processing technologies that minimize the generation of wastes at the source, systems integration of environmental design factors (including life-cycle design, materials recycling, and value-impact assessments), instrumentation for environmental monitoring in production facilities, and development of nonintrusive process diagnostics and controls.

A specific example of benefit to DOE is our program to co-develop, through collaboration with the private sector, lead-free materials and procedures for use in the assembly of nuclear weapon components. Health risks and environmental damage associated with lead-derived solders and fabrication processes that utilize lead have prompted efforts to curtail the use of such materials both in the weapons complex and in private industry. Sandia and AT&T jointly evaluated commercial lead-free solders as well as a new alloy developed by Sandia. The project currently focuses on applications of lead-free solders in nuclear weapon components, including surface-mount operations on a clock board and hand-soldering processes on a firing-set board.

There is a strong push in industry to develop the capability for cost-effective, small-lot manufacturing of tailored products. The term for this is agile manufacturing, and it corresponds to DOE's vision of a smaller nuclear-weapons production complex that can perform small-lot, high-technology fabrication cost-effectively. DOE cannot achieve this vision by itself; it must learn from industry—and develop with industry—the advances in manufacturing engineering that will be required to realize this vision.

2. Cooperative work with industry in areas of common technical interest advances the technology base capabilities for DOE or other agency missions on the 3–10 year horizon.

A specific example of this type of benefit to DOE programs involves co-development of practical optoelectronic technologies with industry. Optoelectronic components offer strong advantages over electronic components in terms of immunity from electrical noise and static electricity, freedom from interference, and directionality. This features can directly impact a variety of DOE program needs in the 3–10 year time frame, including:

- Optical firesets and optical transmission of energy for improved surety in nuclear weapons
- Ring-laser gyroscopes

- Detectors and modulators for wide-area networks for secure communications
- High-performance photonic microprocessors, computers, and device communications

Sandia is a leader in the development of photonic and compound-semiconductor integrated circuit manufacturing processes. We invented strained layer superlattice (SLS) semiconductors in the early-1980s as designer materials for maximizing device performance by optimizing device structure. Sandia not only pioneered several SLS applications in optical emission (including vertical-cavity microlasers), detection, and light-wave modulation, but also led the application of strained-layer materials to transistors and integrated circuits. SLS technologies are responsible for the highest performance, longest-lived lasers, as well as the highest performance, highest efficiency transistors and integrated circuits.

Unfortunately, the generic SLS invention was not patented by Sandia or DOE; rather, it was disclosed in the open literature. With no generic patent protection, U.S. firms abandoned the field to foreign companies who were best positioned to take the increased long-term development risks. This situation changed, however, after the National Competitiveness Technology Transfer Act of 1989 encouraged cooperative research, aggressive intellectual property protection, and commercial-style licensing. Since then, several U.S.-owned companies have entered into cooperative R&D agreements with Sandia to further develop and commercialize strained-layer superlattice technology and associated manufacturing techniques for optoelectronics. Government programs are benefiting from the emerging domestic sources for this critical defense technology. The SLS technology CRADAs are directly relevant to proposed programs for radar fuzes and for inventory, reporting, and communications for future self-aware weapons. Furthermore, we anticipate that some of the intellectual property provisions of the legislation before this committee will enhance our ability to commercialize SLS and other emerging technologies, thereby assuring domestic sources for critical defense electronics and enhancing the strength of the U.S. electronics industry.

3. Cooperative work with industry on carefully selected civilian or defense projects can exercise critical DOE competencies that must be maintained but are critically underutilized.

Cooperative projects of this sort help ensure that the technical skills of laboratory staff remain up-to-par to meet future DOE needs. Sandia has for many years worked as a partner with industry on DoD programs that can benefit from unique defense-related technologies. Such work exercises the applied engineering skills that underlie DOE's nuclear weapon competencies. More recently, commercial-sector projects are helping DOE laboratories maintain these unique skills.

For example, about three years ago, Sandia became concerned that its world-class parachute technology group was approaching a critically low level to meet potential program needs. High-performance parachutes are essential components of several DOE and DoD weapon systems. They directly affect the performance, mission effectiveness, and reliability of the weapon and are vital to the survivability of the delivering aircraft. Over the years, Sandia has developed the science and technology for packaging extremely large parachute systems into very small canisters for gravity bombs.

We have been fortunate to collaborate with an industrial entity that can apply these essential parachute design skills to a commercial product. Precision Fabrics Group, a supplier of textiles for high-performance parachute systems, signed a CRADA with Sandia in 1992 to work with them to develop lightweight automobile airbags. Beginning in 1997, all cars sold in the United States will be required to have both driver-side and passenger-side front airbags. All light trucks

will have dual airbags in 1999. Current automotive airbags are bulky and displace convenience features such as glove compartments and storage bins. They do not easily fit in the limited space available for side-mounted airbags. Thus, reducing the weight and volume of automotive airbags while keeping their manufacturing costs low was a high priority for the industry.

The first step in this CRADA was to determine the feasibility of designing a driver-side airbag weighing only 50 percent of current designs. The Sandia/PFG team created airbag configurations that pass stringent inflation and impact tests even though they weigh approximately 60 percent less than current commercial designs. On the basis of these tests, PFG was able to attract the interest of DuPont, TRW, and other industry participants. These new participants have approached U.S. and European automobile manufacturers who are eager to evaluate our designs for use in their cars. If testing success continues, we anticipate that our airbag designs will be incorporated into 1997 model year cars in the United States and Europe. The market for airbags is expected to reach $2 billion per year beginning in 1997, not counting sales from a new market demand for side-impact airbags.

This collaboration has helped the weapons program maintain a critical skill that is not duplicated in industry. It has also helped U.S. industry lead the world in a technology with a vast commercial market. In my view, this is one example of the kind of collaborative work with industry that is necessary and appropriate for the DOE national laboratories.

How Industry Benefits from Collaboration with the National Laboratories

Many technical advances originating in the DOE laboratories have had a profound impact on whole industries. For example, the supercomputer industry was born in the nuclear-weapons program. The vertical laminar-flow clean room was invented at Sandia and contributed to the growth of the commercial semiconductor industry. In the 1970s we worked with industry to develop synthetic diamond drill bits that gave new life to a troubled industry. The solar energy industry in this country, which enjoys a substantial export market, was enabled by research and development in the national laboratories. Today, an entirely new industry employing pulsed power accelerators for a variety of commercial applications—destroying chemical wastes, hardening metals, joining dissimilar materials, sealing ceramic surfaces, and electronically destroying food pathogens, for example—may develop as the result of collaboration between the DOE national laboratories and the private sector. Development of an industrial base in this processing technology (for which the term *"Quantum Manufacturing"* has been coined) will support Sandia's strategic DOE mission responsibilities.

The truth is, the DOE laboratories are the source of hundreds of technical advances that have proved to be highly relevant to a broad range of industrial needs. Non-CFC cleaning processes, fluxless soldering, reliability testers for semiconductor fabrication, robotic manufacturing processes, chemical dynamics software for controlling industrial chemical processes, advanced welding techniques, diagnostic devices for combustion chambers, rapid prototyping techniques—and on and on.

Not only have the national laboratories provided useful technology to industry, the volume of collaborative work is expanding and industry is paying more of the bill. In 1991, industry contributed 50 percent of the direct costs of cooperative research and development with Sandia. For the past three years, that figure has been closer to 60 percent. "Funds in" arrangements are becoming more common. Technical assistance, user facility programs, and royalties from licenses provide a growing stream of funds contributed by industry. This trend is evidence that

industry believes it is getting something of value from its collaborative work with a national laboratory.

Sandia's Strategy for Technology Transfer and Industrial Collaboration

Sandia's strategy for technology transfer and industrial collaboration comprises the creation of large-scale strategic alliances with industry groups, expanded offerings of DOE laboratory user facilities, development of technology "road maps" with industry, and technical assistance to small and medium-sized enterprises.

Large-Scale Strategic Alliances

Sandia's strategy for technology transfer has evolved from maximizing the number of small CRADAs to seeking large-scale precompetitive alliances with industry and universities. In the last two years, we have begun to focus on team arrangements with clusters of companies and larger-scale alliances in which the capabilities of DOE laboratories, industry, and universities are combined to pursue mutually compatible R&D interests. Many of our newer cooperative projects involve clusters of companies representing a substantial segment of a specific industry, or involve working with organizations that represent an entire industry.

For example, we are working with a cluster of companies under a cooperative R&D agreement with MacNeal Schwendler Corp., PDA Engineering, Fluid Dynamics International, Goodyear Tire & Rubber Company, and Ford Motor Company to develop three-dimensional mesh-generation software to shorten the cycle time for developing production prototypes. This consortium is conducting precompetitive generic research that will benefit the entire industry. It is also enhancing Sandia's strategic initiatives in advanced manufacturing and advanced information technology, core competencies that are critical to the nuclear weapons program for designing electrical and electromechanical components. Each industry participant will use the software to develop a commercial product or service in the area of computer-aided engineering or in applications for finite element analysis—a powerful numerical method useful in many industrial engineering applications, including structural mechanics, electrical engineering, and fluid mechanics.

Fastcast Consortium, Inc., is a group of seventeen companies that have banded together with Sandia to advance the state of the art in investment casting. Member companies range in size from giant Ford Motor Company to tiny Trucast (a five-man outfit in Louisville, Kentucky). Sandia National Laboratories uses investment casting to provide lightweight, high-strength housings for electrical assemblies in nuclear weapons. Advances by Sandia and the consortium include computer software that allows engineers at different locations to work on a casting design simultaneously; computer programs that predict how molten metal will flow into a mold (for use in mold design); mesh-generation and finite element codes that predict casting performance; and selective laser sintering and stereolithographic techniques that produce solid models of castings for use in rapid prototyping. Sandia has identified one of the consortium companies as a possible supplier of weapon housings.

In another collaborative research program, Sandia's strategic initiative in advanced manufacturing technology is again strengthened. We are working with the strategically important U.S. specialty metals industry to improve the technology base for melting processes used in manufacturing specialty metals. Specialty metals, such as high-performance steel and titanium or nickel-based alloys, are critical to American economic competitiveness in areas ranging from

microelectronics to airplanes and are also vital to national security. The consortium has conducted several major investigations. Most of the research has taken place within Sandia's Melting and Solidification Laboratory complex, which features the only large-scale, fully instrumented research furnace in the country. Research is enabling and generic in nature so that each member company can develop its own proprietary processes and products. Patents resulting from this work will be made available to consortium members through a royalty-free licensing arrangement.

Sandia's strategic initiative in electronics technology relies heavily on collaborative interactions with the semiconductor industry. Industry participants include such major firms as Intel, IBM, AT&T, Hewlett Packard, National Semiconductor, Signetics, and Texas Instruments. A five-year CRADA with SEMATECH, which is itself a consortium, is aimed at developing improved semiconductor manufacturing technologies for the next generation of integrated circuits, including equipment that reduces manufacturing costs while increasing yield. This CRADA builds on a relationship established with SEMATECH in 1989 when Sandia's Semiconductor Equipment Technology Center was formed. It also extends a 1992 agreement that established the Contamination-Free Manufacturing Research Center at Sandia to study ways to reduce trace levels of contamination in semiconductor manufacturing, a critical problem facing microelectronics manufacturers. These collaborations help Sandia advance its strategic initiative in electronics technology, which is an exceedingly important core competency for the DOE national security mission.

DOE User Facilities

Another facet of DOE's strategy for industrial collaboration and technology transfer is the designation of user facilities at the national laboratories for cooperative research and development by and with industry users. Sandia's user facilities perform substantial scientific and engineering research that is of value to both industry and DOE.

One of the oldest and most successful of DOE's user facilities is the Combustion Research Facility (CRF) at Sandia's laboratory location in Livermore, California. The facility was established back in the 1970s expressly to preserve an essential core competency of the nuclear weapons program by expanding the user base for those skills. The CRF made use of Sandia's leading-edge capability in laser diagnostics, which had been developed for use in the nuclear-weapons program. During the last twenty years, the facility has been one of the most consistently successful examples of collaborative research involving a national laboratory, industry, and academia. The facility utilizes cooperative working groups to optimize collaboration among industrial, university, and national laboratory participants. Industry partners in these working groups have included General Motors, Ford Motor Company, Chrysler, Cummins Engine Company, Exxon, Navistar, Unocal, GRI, AGA, and Lennox Industries, as well as small companies.

The Combustion Research Facility provides substantial technology transfer to small and medium-sized businesses as well. For example, an instrumented head gasket for studying the combustion process in production engines was developed in response to direct inquiries from industry. The gasket, which earned an R&D 100 Award, incorporates ionization probes that detect the position of the flame in the cylinder, permitting measurement of combustion uniformity in an engine under development. The technology for this diagnostic gasket was

transferred to DSP Technology, Inc. of Fremont, California, a small business, which now manufactures it.

Today, Sandia has many user facilities and technology centers that are performing dual-benefit collaborative work with industry and universities. These research centers and user facilities represent core technical capabilities for DOE missions and are available for collaborative technology development with industry and universities. The research and technology development activities conducted at these facilities satisfy a broad spectrum of dual-benefit needs for government and industry.

Technology "Road Maps"

Sandia and other DOE national laboratories have been active with major industry trade associations to help develop precompetitive technology strategies or "road maps" that outline technical and business strategies for cooperative research on industry problems. For example, a couple of years ago the Semiconductor Industry Association issued a technology plan for the U.S. microelectronics industry through the year 2013. The plan was assembled by 179 top U.S. semiconductor experts from industry, government, and universities. This road map identified opportunities for the DOE multiprogram laboratories to help industry address their generic technology needs.

In response to the Semiconductor Industry Association's directly stated needs, Sandia established its Center for Microelectronics Technologies to assist the industry in dual-benefit projects. This center was created by combining the existing DOE-funded Microelectronics Development Laboratory at Sandia with a major donation of equipment and research instrumentation from IBM valued at over $20 million. The center will encourage partnership projects with U.S. microelectronics manufacturers and universities to develop the technologies, manufacturing equipment, and advanced processes upon which the future of both commercial and defense electronics depends. The center also serves as an arena through which U.S. graduate students are trained in the most advanced integrated circuit technologies in the world.

A combined governing board chooses projects that create teams of researchers selected from universities, industry, and the DOE laboratories with major industry partners who agree to commercialize the results. The federal government is a major beneficiary of this joint work, both through the development of custom products for government applications and through support for the domestic manufacturing base that provides these products.

Similarly, the U.S. Optoelectronics Industry Development Association (OIDA) created a technology road map to chart a course for joint action to advance industry opportunities in the emerging optoelectronics market. OIDA selected five critical areas for joint research and development at the precompetitive stage. Two of the critical enablers—optoelectronic materials and optoelectronic manufacturing processes and equipment—are areas in which Sandia has recognized technical leadership. Sandia's Compound Semiconductor Science and Technology Center provides an ideal facility at which cost-leveraged partnerships involving industry, universities, and government researchers can perform the precompetitive development of the design tools, processes, and related production equipment essential for U.S. optoelectronics manufacturers. As with the Semiconductor Industry Association's road map, an advisory board recommends projects that combine teams of researchers from both government and industry laboratories and universities.

Sandia has recently been active in the National Electronics Manufacturing Initiative (NEMI). This initiative was launched by the National Science and Technology Council and private industry to promote collaborative development by industry, government, and academia of the underlying technology and infrastructure required to promote the manufacture of new electronic products in the United States. The most recent output from this initiative is a set of technology road maps that identify critical gaps in the electronics manufacturing "food chain." The next step will be to set priorities in electronic manufacturing science and technology and determine where it makes the most sense for government and industry to work together to fill these gaps.

These examples of industry/university/DOE laboratory teamwork based on industry-defined road maps are a glimpse into the future of joint-sector collaboration. The benefits accrue to the industry as a whole, and DOE's essential technical competencies are strengthened.

Technical Assistance to Small/Medium-Size Enterprises

The national laboratories have been working hard to provide technical assistance directly to small and medium-sized enterprises. Sandia, Lawrence Livermore, and Los Alamos national laboratories and the Y-12 production facility at Oak Ridge have established a joint Small-Business Technology Transfer Program. This program is a follow-on to the successful National Small-Business Technology Exchange Program. We work with small-business development centers, cooperative extension services, bankers, chambers of commerce, state economic development agencies, and vocational education teachers to identify technology partners. Included in the program are regional, short-term technical assistance programs in New Mexico, California, Arizona, Texas, and the Midwest. Also included are partnerships with industry associations to reach a greater number of small business participants by addressing common problems and opportunities and matching laboratory capabilities with the needs of small businesses.

Technical assistance to small and medium-sized companies increases the return on the federal investment in DOE's technical assets to the taxpaying public at minimal incremental cost. Let me give you a specific example:

Over a twenty-year period, Sandia developed a world-class program to apply very hard surface coatings to parts for nuclear weapons. The technology, based on super-high-temperature plasma flames, can also produce coatings for superior commercial products as well. Fisher-Barton, a small Wisconsin company that specializes in manufacturing lawn mower blades, recognized the potential for application of this process in several new areas, and recognized that Sandia could facilitate their entry into new markets. Fisher Barton paid the salary for one of their engineering employees to work for a year side-by-side with Sandia scientists; DOE provided a $57,000 award to help defray living expenses and costs for experiments of particular interest to industrial use. (This award was essentially an early form of the now-popular Cooperative Research and Development Agreement [CRADA]). Fisher Barton gained sufficient experience to launch a new service. Two patents resulted from the joint work of the Fisher-Barton employee and Sandia engineers. In 1994, Fisher-Barton established a new company, Thermal Spray Technologies, in Sun Prairie, Wisconsin.

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Here is a summary of the economic costs and benefits of this technology transfer as analyzed by a team of university economists:[2] The Department of Energy invested about $3.7 million over a twenty-year period to develop this technology for nuclear weapons and other DOE program needs. The incremental cost to the government for supporting the Fisher-Barton effort was only $57,000. An assessment at the end of 1994 showed that the gross economic benefit to Fisher-Barton, its community, and its customers was already close to $25 million. The benefit to cost ratio is about 300 to 1. One should also note that additional side benefits have been identified. For example, another company's manufacturing operation for bicycle wheels will be retained in the United States, owing to the special value-added services of Thermal Spray Technologies.

This is an excellent example of how laboratory-industry collaboration in technologies that support established DOE mission requirements can provide great leverage for broad economic benefit.

Conclusion

The technology bases for government and commercial needs are rapidly converging. Collaboration with industry is essential for helping the national laboratories maintain and advance mission-related competencies. At the same time, there are many compelling examples of collaboratively developed technology that has helped industry make new or better commercial products.

Mutually beneficial collaborations with individual companies will continue to play a significant role in technology transfer, but increasing emphasis should be placed on large-scale strategic alliances for generic, precompetitive research and development that can be broadly useful for an entire industry. More laboratory user facilities should be designated so that private companies can gain access to the federal R&D infrastructure. Technology "road maps," developed by industry with the input and assistance of the national laboratories, should be more widely exploited to develop action plans for achieving strategic technical objectives with national significance. Finally, technical assistance by national laboratories to small and medium-sized companies is a responsible way to increase the return on the federal investment in DOE's technical assets to the taxpaying public at minimal incremental cost.

The proposed legislation, subject to the changes suggested in the appendix to this statement, will make it easier for federal laboratories to license jointly developed technology to industry and to provide appropriate royalty-based incentives and compensation to inventors and other enabling personnel. By passing this legislation, Congress will acknowledge and endorse a defined role for technology transfer and cooperative work between the national laboratories and industry.

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[2] *Technology Transfer Impact Profiles*. Santa Falcone, University of New Mexico; Barry Bozeman, Georgia Institute of Technology; Albert Link, University of North Carolina, Greensboro; and Maria Papadakis, James Madison University.

APPENDIX

Comments on Draft Legislation
Proposed Amendment to 15 U.S.C. § 3710a
"Technology Transfer Improvements Act"

Addendum (1) The proposed amendment refers to 35 U.S.C. § 202 (a) and (b), which were provisions established by the Bayh-Dole Act. The policy established by the Bayh-Dole Act under sections 202 (a) and (b) enables small business firms and non-profit organizations to elect to retain title to any subject invention, subject to certain U.S. government rights, conditions, and exceptions. For example, the Government rights include a nonexclusive, nontransferable, irrevocable, paid-up, license to the subject invention for government use; "march-in" rights; and the right to require domestic manufacturing in exclusive licenses.

The intent of the proposed amendment appears to be consistent with the intent of the Bayh-Dole Act, which was to provide a uniform patent policy with respect to small business firms and nonprofit organizations regardless of the funding agency. As it stands, however, the proposed amendment may be ambiguous because it does not employ the same language as that found in 35 U.S.C. § 202. The language of the proposed amendment should mirror the language of the Bayh-Dole Act to avoid unnecessary confusion and interpretation if the bill became legislation. Thus, the proposed subsection D could be amended as follows (additions underlined, deletions bracketed):

"11(D) Nothing in this paragraph shall be construed to take precedence over the application of Section 202 (a) and (b) of Title 35 of the United States Code to intellectual property conceived or first actually reduced to practice by small business firms and nonprofit organizations, qualifying as such under Section 202 (a) and (b) of Title 35, in the course of projects awarded under [this program] the Program [by United States universities and nonprofit independent research organizations qualifying under such Section]."

Sec. 3 "(b)(1)" p. 3, ll. 9–10 These lines permit a laboratory to grant assignments of title in advance to a collaborating party. This provision is consistent with our desire to move the authority for making such decisions closer to the field and away from a centralized bureaucracy. However, Sandia's current prime contract with DOE requires agency approval for assignment of title and will therefore preclude us from taking advantage of this provision. It would be helpful if the legislation were to include a provision requiring Federal agencies to amend any government-owned, contractor-operated (GOCO) laboratory managing and operating contracts (such as the prime contract between DOE and Sandia) to reflect the intent of the legislation.

Sec. 3 "(b)(1)" p. 3, ll. 12–13

We note that the phrase, "for reasonable compensation when appropriate," raises questions that will probably be delimited through agency rule-making (e.g., What is "reasonable compensation?" and "When is it appropriate or inappropriate?"). It is possible that agency rule-makers will take a long time to promulgate complex regulations to define these terms. Perhaps there is some way to minimize the rule-making requirements implied by this phrase.

Sec. 3 "(b)(1)" p. 3, ll. 13–20

These lines give a collaborating party the option to obtain an exclusive license for an invention made in whole or in part by a laboratory employee under an agreement. An exclusive license can be very helpful for a company assuming the risks of commercializing a technology. Accordingly, we already use exclusive licensing in most CRADAs involving industry sponsorship, usually with field-of-use and/or time limitations. Our experience is that industry is not shy about insisting on the broadest possible scope of rights. The proposed requirement that the laboratory grant an exclusive license in a field-of-use adds no new authority. It also begs the question, because exclusivity per se is not valuable. Value lies in the scope of the field-of-use. That will still have to be negotiated as it is now, adding confusion over what the drafters intended by this change. Finally, the potential for antitrust problems exists if the industry party already enjoys market dominance.

We believe that these potential problems can be eliminated by removing the sentence that begins on line 13 with, "The laboratory shall ensure . . . ." Removing this sentence will still permit the granting of exclusive licenses when appropriate, but would protect the laboratory from undue pressure to grant such licenses when it is otherwise inappropriate or unwarranted. If the exclusive licensing requirement stands, the laboratories will need immunity from suit under the antitrust laws.

Sec. 3 "(b)(1)(B)" p. 4, ll. 12, 18; and Sec. 3 (b)(1)(C) p. 4, l. 25 p. 5, ll. 4–5

We think it is not beneficial to introduce the concept of compulsory licensing by the Government into the CRADA statue. Industry, with good reason, objects to such "march-in" provisions. DOE has made a policy choice to require march-in rights in its CRADAs. It is undesirable to codify it as a positive requirement. If the compulsory licensing provision stands, we suggest that the phrase "collaborating party" be changed to "assignee or exclusive licensee" in the event that the collaborating party is not the same as the assignee or exclusive licensee. This change should be made to the occurrences cited here and to other appropriate occurrences elsewhere in the draft legislation.

Sec. 3 "(b)(1)(B)(ii)" p. 4, ll. 18–19

The phraseology of this paragraph is somewhat awkward and could lead to misunderstanding. We suggest substituting "to grant such license itself if the assignee or exclusive licensee fails to grant such a license."

Sec. 3 "(b)(1)(C)" p. 4, l. 23 – p. 5, l. 7

Apparently, the clauses listed (i-iii) were modeled after 35 U.S.C. § 203. One retained right that appears to be omitted from the proposed amendment is the Government's right to "march in" when the assignee or exclusive licensee suppresses an invention. It would be prudent, from a U.S. competitiveness viewpoint, to include such a clause. See 35 U.S.C. § 203(1)(a) for sample language.

Sec. 3 "(b)(2)" p. 5, ll. 9–11

Under 42 U.S.C. § 5908, the Department of Energy has the option to waive title rights with respect to inventions made by persons under an agreement with DOE. This legislation has the options reversed and appears to be in conflict with 42 U.S.C. § 5908.

Sec. 3 "(b)(3)" p. 5, l. 14 – p. 6, l. 4

Apparently, the provisions listed (clauses A–C) were modeled after the existing Stevenson-Wydler Act. One enumerated authority omitted is 15 U.S.C. § 3710a (b)(3). We strongly suggest adding that paragraph into the proposed amendment. This provision allows DOE to grant a collaborating party an advance waiver of an invention made or conceived under a cooperative research and development agreement (CRADA). In the absence of such a provision, the party would have to endure the additional administrative burden of petitioning DOE for an identified waiver of rights to each and every CRADA invention. Also, the clause allows a determination of Government rights. We can conceive of no good reason to omit this clause.

Sec. 3 "(b)(3)" p. 5, l. 12

Another enumerated authority omitted from this paragraph is 15 U.S.C. § 3710a (b)(4). We strongly suggest adding that paragraph into the proposed amendment. This provision allows laboratories to determine intellectual property rights under a CRADA. We can conceive of no good reason to omit this clause.

Sec. 3 "(b)(3)(C)" p. 5, l. 23 – p. 6, l. 4

We suggest that employees of GOCO (government-owned, contractor-operated) laboratories be explicitly authorized to participate in invention commercialization efforts in the same manner as provided for Government employees in this provision.

Sec. 3 "(b)(5)(B)" p. 6, ll. 16–17

This change omits the purpose listed in § 3710 (c)(a)(1)(B)(ii) which allows for payments to other employees such as developers of classified technologies. Sandia currently includes such language in its royalty sharing plan and the statute presently authorizes it. We do not feel it should be removed with this amendment. It is suggested that the draft legislation meant to exclude clause (iii), not clause (ii), as excluded in the legislation that is presently in force.

Sec. 4 pp. 6–11 This section on "Distribution of Income from Intellectual Property Received by Federal Laboratories" changes a section of the current law that presently applies only to GOGO (Government-Owned, Government-Operated) laboratories by placing the GOCO (Government-Owned, Contractor-Operated) laboratories under its requirements as well. We believe this mixture will not work well. The salient difference is that GOCOs are privately managed, have private employees, and generally follow the management practices of the private sector. We believe it makes more sense to grant GOCOs the flexibility to pattern their royalty sharing plans more closely after those found in the private sector.

Sec. 4 (1) "(1)" p. 7, ll. 10–12 These lines give control of royalty payments to the sponsoring federal agency rather than directly to the laboratory that licenses an invention. This provision is inconsistent with the trend to devolve administrative control to the field and away from a centralized bureaucracy. As written, this provision will require the creation of a new agency office to administer, approve, and disburse royalty payments. This will result in greater overhead costs, additional agency rule-making and adjudication, and the inevitable administrative delays and inefficiencies of centralized administration.

We believe it would be more efficient and cost-effective to authorize the laboratories to directly retain and dispense royalty payments in accordance with the guidance contained in this legislation.

Sec. 4 (1) "(1)(A)(ii)" p. 7, ll. 18 – p. 8, l. 2 The vaguely bounded time period ("the time that the intellectual property rights to such inventions are legally asserted") would exclude laboratory technicians and other staff members that assisted an inventor during the early stages of the development of an invention. An alternative provision could be worded similar to the following:

"(ii) An agency or laboratory may provide appropriate incentives, from royalties or other payments, to laboratory employees who are not inventors of such inventions and who substantially increased the technical value of such inventions."

Sec. 4 (1) "(1)(B)(i)" p. 8, l. 20 We note that "payments to inventors," included in the present legislation, is omitted from the proposed amendment. Presumably, payments to inventors are already provided for in (4)(A). However, that paragraph does not account for inventors of classified inventions. It seems more appropriate to use the language of the present legislation, which provides for both "inventors and developers of sensitive or classified technology, regardless of the [commercial potential]."

Sec. 4 (3)(D) p. 10, l. 24 Confusion may be avoided by deleting the words, "offsetting the."

Sec. 5 (1) p. 11, l. 14 Change "Act" to "chapter." We believe the quotation is incorrect as written.

Mr. SCHIFF. Mr. Cochran, if you could take five minutes on your summary?

STATEMENT OF RONALD W. COCHRAN, LABORATORY EXECUTIVE OFFICER, LAWRENCE LIVERMORE NATIONAL LABORATORY

Mr. COCHRAN. Thank you, Mr. Schiff. I'm happy to be here to discuss with you Lawrence Livermore's experience with industrial partnering. I would like to hit some of the points that came up earlier, and just be clear from a laboratory standpoint where we are on those.

First, I'd like to make it very clear that Livermore considers industrial partnering with tech transfer really vital to the current and future success of our programs. This is not a giveaway to anyone. Our experience is that both parties are leveraging their investments to get additional benefits for the nation out of the funds that are being expended. And we see that every day.

Second, I think that the leadership that Congress has provided in establishing the legislative framework and protection necessary to do this has been vital. This simply wouldn't have happened otherwise.

Times change. We've got experience now. And we can learn to make things better. But I think that the proposed legislation will further enhance these activities. So we strongly support that. We simply wouldn't have gotten to this point without that kind of incentive and leadership.

To make these efforts flourish, we're going to need to continue to employ a wide variety of approaches. One arrangement simply doesn't work in all cases. CRADAs aren't the answer for everything. Licensing is helpful in some things. But we need a wide variety, a menu of those kinds of arrangements to get the best benefit for the nation out of these activities.

So we would like to continue to do that. But we've become convinced that industrial partnering with technology transfer is the best way for us to do business. So we're going to make it an integral part of how we do business in the future, because it pays off for the nation.

I might point out that this is not really overall a new approach. We've used industrial partnering for many years in some ways. There are approaches whereby, through procurements, you enhance a company's ability to provide certain products, and you buy those. That works. It ought to be used.

There are other areas, like the supercomputer industry, where the requirements of the weapons program have really set the outer envelopes of the need for those products in that industry. That works, and we should continue to use it.

More recently, CRADAs and enhanced licensing have provided vehicles that have given us the opportunity to protect intellectual property and do things that we couldn't do otherwise. So we ought to use those.

At Livermore, we've now entered into 182 CRADAs where there were 200 companies that represent over a half-billion dollars worth of program activities. That's going to be very important for the nation. That involves small businesses—about 65 of those are small

businesses. And it involves producing things that simply would not have come out of the national security development activities otherwise.

Licensing is also very important. We have now entered into excess of 100 licenses. We see that growing. The revenues from those licensing and royalties are increasing by substantial amounts.

In '94, we had about $500,000 from that. This year, we expect about three times that much. We expect that to get into the $10 to $20 million a year range within 10 years. So those are starting to become important, and we think that is exactly what should come out of these kind of arrangements.

And we need the flexibility, as we try to enter into these agreements to make a unique deal aimed at making sure that intellectual property is protected, but that the technologies are commercialized as early and as broadly as possible, because that's the real payoff.

So we would ask for that flexibility as you proceed with developing your legislation.

And I guess, finally, the question of metrics is always a tough one. We've done some soul-searching on how to best deal with that. I guess one of the things that we feel best about is simply asking industry. You know, we see industry continuing to come to offer to invest their money, to partner with us in these various activities.

And industry is not investing its money unless it sees a real payoff. Now, we get a payoff from the programmatic side, because we're able to access their technologies, and able to buy things more cheaply. So we're leveraging the government's money to do our job. But they're leveraging their money to create jobs, and enter into new areas. And so, that feedback from industry is what we are looking at as the principle metric for whether or not we're achieving our objectives.

So I'd like to suggest, listen to industry on that one. We'll go with what they say. We have a wide range of agreements that we can enter into with industry, and we'd like to continue to use that full set. With that, I'd like to close my remarks, and thank you for the opportunity.

[The prepared statement of Mr. Cochran follows:]

TECHNOLOGY TRANSFER THROUGH INDUSTRIAL PARTNERING

Joint Hearing of the
Subcommittee on Basic Research and the
Subcommittee on Technology
of the
Committee on Science
U.S. House of Representatives

June 27, 1995

Ronald W. Cochran, Laboratory Executive Officer
University of California
Lawrence Livermore National Laboratory

INTRODUCTION

I am the Executive Officer of the **Lawrence Livermore National Laboratory** (LLNL) and represent the Laboratory here today. We were founded in 1952 as a nuclear weapons laboratory, and national security continues to be our core **mission.** In addition, we have major programs in energy, environment, and biosciences. Our permanent staff numbers approximately 7300, with over 1000 Ph.D.'s distributed over a broad range of disciplines in the physical sciences and engineering.

I welcome the opportunity to speak to you about our Industrial Partnering activities at LLNL and to comment on the draft **"Technology Transfer Improvements Act of 1995,"** which is intended to enhance the process of commercialization of technologies developed in partnerships between federal laboratories and private industry. In my remarks, I intend to highlight:

- ***The mutual benefits of Industrial Partnering.*** We pursue Industrial Partnering to support and enhance our programmatic efforts to meet important national needs in a cost effective manner. At the same time, American industries can tap into our cutting-edge technologies, capabilities, and facilities to bolster their competitiveness in the global marketplace. It is a fruitful relationship, and we are concerned that reduction or elimination of DOE Defense Programs Technology Transfer Initiative funding in FY1996 will be very disruptive to contracted, on-going partnership activities that directly contribute to vital national security work.

- ***The process of forming Industrial Partnerships.*** I will discuss how it works and improvements we are making. Partnership agreements that

took 18 months to execute in 1991 now at times can take less than 90 days, from start to finish.

- *Issues about the Technology Transfer Improvements Act of 1995.* We agree with the legislation's overall intent to improve the commercialization process. However, we have some specific concerns that stem from language pertaining to the granting of exclusive licenses, which needs clarification and qualification.

THE MUTUAL BENEFITS OF INDUSTRIAL PARTNERING

Industrial Partnering is integral to the way we pursue programmatic activities at LLNL because it makes good business sense. Our joint efforts with industry apply core mission capabilities to problems of mutual interest and enhance those capabilities. Mutual interest means that there are prospective mutual benefits. Three very important aspects of our interactions with industry have emerged:

- *Meeting LLNL Program Goals Cost Effectively.* We derive very real benefit from executing some of our mission-related work in concert with the commercial sector. This strategy has the virtue of cost-effectiveness, because all the needed expertise does not have to be retained within the Laboratory. It also allows both the Laboratory and industry to acquire knowledge and competence by applying their skills to a broader range of problems. And, it provides the Laboratory early access to the $70 billion annual industrial investment in research and development.

- *Partnering with Industries in which LLNL and other DOE Labs Drive the Market.* The Laboratory's missions do, in fact, drive very special segments of high-technology industry. The supercomputing industry was essentially created in response to defense needs, high power and precision optical firms are strongly supported by Livermore's laser program, and high-speed electronics have an important customer in our experimental physics program.

- *Enriching the U.S. Economy with LLNL-Developed Technologies.* There are a set of real commercial applications for some of the technologies developed to meet program needs. The examples are numerous, ranging from a computer code that is estimated to save U.S. industry over $300 million per year (e.g., used to simulate automobile crashes), to a miniature radar system developed at our Laboratory that promises to have a very large impact in the commercial world. Moreover, LLNL has received 55

prestigious R&D100 Awards for scientific and technological breakthroughs, including five awards this year.

Meeting LLNL Program Goals Cost Effectively

Two important vehicles that LLNL uses for Industrial Partnering to manage program costs are procurements and Cooperative Research and Development Agreements (CRADAs). From a Laboratory perspective, these interactions can lead to joint development of technologies we need and otherwise would have to pursue fully at government expense. These interactions are the most cost-effective way to meet some of our program goals and consequently are very important to us at a time of declining budgets when we need to maintain the very high quality of our work.

Industrial Partnering through Procurement. We have always pursued Industrial Partnering through our procurement strategy. Our state-of-the-art major R&D programs throughout the Laboratory have the choice of using "in-house" precision fabrication capabilities to make needed specialized equipment, parts, and components or procuring them from private industry. The issue for us has been cost efficiency, and to make informed decisions we have considerable interaction with private industry to understand their capabilities and products. An informative overall statistic is that our total commercial purchases in FY1994 amounted to over half LLNL's total budget.

During the decade of the 1960's, we worked in partnership through procurement with several large and small U.S. instrumentation companies to develop a whole new generation of extremely reliable high speed diagnostic equipment needed for nuclear weapons testing in Nevada. These same partnership techniques were used in the 1970's in the highly successful development of the Flash X-ray (FXR) Facility at Livermore's Site 300. Used in the non-nuclear testing of the implosion phase of a nuclear detonation, FXR is currently the most capable hydrodynamic test facility in the world and is critically important to our stockpile stewardship program.

The Inertial Confinement Fusion (ICF) Program at Livermore likewise has a long history of very important industrial partnerships through procurement. The development of the Shiva laser in the 1970's relied to a large extent on such partnerships. The result was the world's most powerful laser enabled by truly world-class optical, electro-optical and laser technologies. In planning for the Nova laser at LLNL in the early 1980's, we continued our strategy of working closely with American suppliers. While DOE, through its laboratories, provided some of the funding and expertise, U.S. manufacturers applied their own resources to achieve the necessary technological advances to meet Nova's exacting requirements. Companies, large and small, acquired new technology and expertise, developed advanced fabrication methods, and

lowered production costs, while creating unique products for the world marketplace.

The next major step in the national ICF program is the National Ignition Facility (NIF). DOE Defense Programs has requested FY1996 funding for Title I design activities and related operating expenses as a step toward its construction. The NIF is critical for stewardship of the nuclear weapons stockpile, for the development of ICF for civilian power production, and for advance of a broad spectrum of scientific and technical fields. Of the total project costs, approximately 75% will go to U.S. industrial partners for equipment and materials, or for design and construction services—directly creating over 1000 private-sector jobs. Low-cost, large-scale precision optics manufacturing techniques will be greatly advanced by the requirements of NIF, as will laser and electro-optics technologies, high-speed instrumentation, micro-fabrication, and advanced imaging devices.

Industrial Partnering through CRADAs. The passage of the National Competitiveness Technology Transfer Act of 1989 permitted the (government-owned, contractor-operated) DOE national laboratories to execute CRADAs to jointly pursue R&D activities while protecting the intellectual property rights of the participants. We signed our first CRADA in 1991 soon after the University of California contract with DOE was amended to allow such activities at LLNL. As information about CRADA opportunities has become more widely known within and outside the Laboratory, the number of LLNL CRADAs and the dollar amount involved have grown at a rapid rate. As of the end of May 1995, we have executed 182 CRADAs (involving 200 companies, including 65 small businesses) with an estimated dollar value of $556 million. Last year, about 6% of the Laboratory's budget was applied to Industrial Partnerships.

In our CRADA activities, no public funds are transferred to our Industrial Partners. Slightly less than half of the $556 million total is public money projected to be spent in the Laboratory over a period of several years. Slightly more than half is private money invested by our Industrial Partners principally in their own R&D facilities. The benefits are mutual. We have learned a lot from industry and most of our partners have learned from us. We are able to reduce development costs and gain the option of procuring either capability or equipment with potentially significant cost saving. Industry has been able to bring new products to market quicker and more cheaply because of the partnerships. In addition, Laboratory vitality and staff morale have been enhanced by this dynamic association with industry, addressing new and challenging problems to benefit American businesses, workers, consumers, and taxpayers.

Besides the growth in the level of CRADA activities, several important trends are noticeable. Increasingly, CRADAs involve consortia of companies (and laboratories) to address the particular needs of an industrial sector (e.g., textiles, automotive, semiconductors, etc.). In addition, the process of forming CRADAs is becoming more routine so that there are fewer delays. Furthermore, what we learn from earlier CRADA outcomes helps us to improve how we do business. Finally, we are becoming increasingly selective in our choice of CRADAs to align these activities even more closely with our most important Laboratory program objectives.

To realize cost savings to the Laboratory, CRADAs must be integrated into programmatic activities and contribute to programmatic goals. A comparison of current LLNL CRADA activity to our core competencies and programmatic thrusts provides one indication of integration. As a multi-disciplinary laboratory, LLNL has applied its considerable skills in areas such as high-performance computing, advanced materials engineering, and the management of large research and development projects to national needs in defense, energy, the environment, and biotechnology. Approximately 30% of the Laboratory's CRADAs are in the materials and manufacturing area; 18% in computing and communications; 14% in semiconductors, microelectronics and photonics; 11% in electronics advanced manufacturing; 8% in biotechnology and healthcare; 7% in modeling of industrial processes; 7% in environmental and emission reduction; and 5% in the energy field.

The laser program at LLNL has 24 CRADAs with industrial partners, totaling over $160 million in the areas of microelectronics, photonics, information storage, advanced manufacturing, precision optics, biotechnology and environmental research, all of which support DOE missions executed at LLNL. The Advanced Microtechnology Program (AMP) at LLNL is one of the Laboratory's fastest growing industrial outreach activities. In its largest project, extreme ultraviolet (EUV) lithography, the AMP at LLNL collaborates with Sandia National Laboratory scientists to lead eight industrial partners in activities to help regain U.S. dominance in semiconductor manufacturing. This project is aimed at developing technology for integrated circuit production perhaps two generations in the future when feature sizes shrink from microns to one-tenth of a micron. AMP is developing the laser light source, EUV optics, coatings and mask technology required for EUV lithography. The technologies embedded in the LLNL participation in these CRADAs are also essential to the successful completion of NIF.

Nearly all Industrial Partnering activities at Livermore are associated with our national security mission—specifically nuclear weapons stockpile stewardship and maintenance. Over the last several years, DOE Defense Programs' Technology Transfer Initiative (TTI) funding to LLNL provided the

impetus for establishing closer Laboratory-industry ties and the basis for growth of these interactions. Most of our TTI-supported CRADAs support either the Accelerated Strategic Computing Initiative (ASCI), which I later discuss, or are part of the DOE Advanced Design and Production Technologies (ADaPT) initiative, aimed at timely development advanced design and manufacturing technologies required to maintain an affordable, safe, and reliable nuclear stockpile. Important weapons program efforts have been enhanced through these Industrial Partnerships. Examples of TTI-funded CRADAs in two areas demonstrate how these activities support nuclear weapons stockpile stewardship and management:

- *Non-Destructive Evaluation*. We are enhancing the technical basis of stockpile surveillance so that we can better understand and predict the effects of aging on weapons. Important to this effort is development—mostly in collaboration with industry—of non-destructive techniques to enable continuous monitoring of key aging signatures within weapons. As an example, we are working with several biomedical companies to develop endoscopic surgical tools and fiber optic visualization technologies. These dual-use technologies are being applied to inspect nuclear weapon parts and components in locations that are otherwise inaccessible.

  Non-destructive evaluation (NDE) is also important for quality assurance in modern manufacturing. To this end, LLNL is partnering with Boeing to assess the use of positron annihilation spectroscopy (PAS) as a NDE technique to detect incipient material voids and defects in organic materials subjected to various environmental stresses. The aerospace industry requires extensive material certification to assure the long-term strength and durability of carbon fiber composite materials. This certification is both expensive and time consuming. PAS may provide our partner enhanced NDE capability to certify performance lifetime of aerospace materials and provide us a means to validate novel material processing concepts for the manufacture of stockpile components.

  The Laboratory is in its third year of working with one of the major U.S. automakers to apply yet another NDE technique to production-line inspection tasks. "The improved systems have enabled us to cut back on destructive testing by 50%" according to a company engineer, and product quality has improved by 3%.

- *Precision Fabrication and Materials Processing*. LLNL is developing technologies for a cost-effective manufacturing capability to replace aging weapon components or refurbish them to extend their life. DOE must be able to remanufacture weapons at a modest, but scalable production rate in

a low-cost and environmentally benign manner. One area of LLNL focus is precision casting and spin-forming techniques to replace current methods of rebuilding uranium parts. Precision casting provides a simplified process that will reduce waste nuclear material and scrap in weapon component production.

We are making use of partnerships with industries, such as aerospace, that have similar production technology needs. Working with partners with considerable casting experience, LLNL has been developing a computer code that can predict, with accuracy, the final shape and strength of cast-metal parts, as well as problems (e.g., deformation, porosity) that might be encountered during manufacturing.

We are also partnering with Alcoa to produce a computer code for simulation of the fundamental metal forming processes in casting, forging, extrusion and rolling. The code provides DOE both an important tool for research and development of advanced manufacturing processes for weapon components and ideal simulation software for studying the response of weapon systems to severe abnormal environments (e.g., impacts, fuel fires).

Completion of these multi-year commitments to Industrial Partners depends on your support of TTI funding in FY1996, which stands as a separate line item in Defense Programs' budget submission this year. We are concerned that reduction or elimination of DOE Defense Programs' Technology Transfer Initiative funding in FY1996 will jeopardize contracted, on-going partnership activities that directly contribute to vital national security work. More generally, such action would be very disruptive to the progress we have made in establishing mutually beneficial working relationships with industry.

Partnering with Industries in which LLNL and other DOE Labs Drive the Market

LLNL has a natural role in partnering with and helping industries in which our missions push the technology envelope or in which we represent a substantial share of the market. As an example, our national security needs have driven the market for supercomputers for three decades. High-performance computing has always been central to scientific programs at Livermore because we have always needed state-of-the-art computers to simulate the highly complex physics of nuclear weapons to augment our nuclear testing. Iterations in device design could be accomplished more quickly and cheaply on a computer, with proof testing in Nevada.

We have had a history of successful partnerships with private industry and other government laboratories in high-performance computing. In addition,

we have made important contributions in software, operating systems, scientific applications, and computing techniques. Currently, nearly 10% of the Laboratory's annual budget is invested in the development of systems software and applications for all major programs at the Laboratory.

Presently, two factors further enhance the importance to LLNL of Industrial Partnerships in computer software and hardware. First, we are entering a post-Cold War era with no nuclear testing. We must rely even more on high-performance computing to assure stockpile performance, and we need over a thousand-fold increase in computer speed and data storage capacity to model physical effects with greater fidelity and resolution. Second, the future of high-performance computing is undergoing a major transition from conventional (single- or vector-processor) supercomputers to massively parallel processing (MPP) with many microprocessors. To realize the potential that MPP offers, there must be close cooperation among hardware developers, software developers, and users.

As part of the DOE Defense Programs' Accelerated Strategic Computing Initiative (ASCI), the DOE national security laboratories are working with the developers of MPP computers in a multi-year cooperative effort to reduce obstacles to creating efficient, high-performance parallel programs. New numerical algorithms and programming techniques are required for efficient use of the capability of the new machines. In addition, the laboratories are working—in many cases with Industrial Partners—on necessary improvements to information management systems, data storage systems, computer networks, and computer graphics systems.

The ASCI is augmented by the Industrial Computing Initiative (ICI), a $52 million TTI-funded CRADA involving Livermore, Los Alamos, and sixteen Industrial Partners. In the three-year ICI effort, three code development systems will be developed and thirteen scientific application programs will be transformed into efficient, massively parallel models for use by DOE programs and by U.S. industry to improve productivity and competitiveness. As an example, one of the projects being pursued is environmental modeling of subsurface contamination beneath the Laboratory, a capability which has many other important environmental applications for both DOE and industry. These ICI software development activities are breaking the trail for the future of the high-performance computing, which is becoming increasingly important in product development and testing in virtually every industrial sector.

In addition, the DOE national security laboratories are teamed with preeminent industrial organizations like the Semiconductor Industry Association and the National Storage Industry Consortium as participants in

both the DOE and DoD programs in advanced information storage systems and advanced lithography for the manufacture of computer chips. This teaming provides efficient leverage of resources from both Departments to provide the high-performance computing capability needed for all national security programs. Our special expertise in technologies pertinent to advanced lithography and information storage enable us to make important contributions to the overall effort.

One such success story is the National Storage Laboratory (NSL), an effort based at Livermore's National Energy Research Supercomputer Center to research and commercialize technologies for high-performance computer storage of large amounts and diverse types of information. This government/industry partnership has achieved over a hundred-fold improvement in storage-system performance and significant improvements in storage-system functionality. NSL efforts have benefited U.S. commercial vendors of high-performance storage systems, provided capabilities for the national information infrastructure, and helped guide the efforts of the national storage-system standards group.

Enriching the U.S. Economy with LLNL-Developed Technologies

Technologies developed as part of our programmatic work can enrich the U.S. economy through technical assistance to businesses, new product development, and formation of new companies. We move Laboratory-developed technology to the marketplace by licensing and through our Small Business Program.

Licensing. We have negotiated rights to more than 100 Livermore technologies. As patents awarded to Laboratory researchers attract a growing number of companies, our licensing specialists are called on increasingly to expedite the transfer of products and processes to industry, with an eye to creating real economic growth. We publicize information about licensing opportunities, hold discussions with potential licensees under non-disclosure agreements, select a company based on our perception of their ability to bring product-to-market, and negotiate a mutually satisfactory licensing agreement.

An outstanding example of the commercialization potential of LLNL-developed technologies is provided by the Micropower Impulse Radar (MIR), recently featured on the cover of *Popular Science* magazine. MIR was invented by LLNL scientists searching for ways to measure fast laser pulses. The invention uses $10 worth of off-the-shelf components to outperform, in some ways, conventional radar and sensor equipment costing $40,000 and more. It may well transform entire U.S. industries with new generations of "smarter" commercial and industrial products.

Industry has been quick to see the value of this technology. LLNL has received more than 2,000 inquiries, and we have arranged two limited field of use exclusive licenses. One partner is developing a new generation of electronic hand tools that may prove indispensable for the building industry. The firm's president expects the licensing agreement to double or triple revenues for the company in the next three years. The other partner is developing MIR for low-cost safety systems for automobiles. As early as 1997, you may be able to purchase a new car with a back-up sensor to provide warning of obstacles behind you. Later, your automobile may be equipped with a lane change (or "blind spot") alarm system and a cruise control system to keep the car at a set distance from vehicles in front of it.

To achieve rapid commercialization, we are licensing many remaining fields of use on a non-exclusive basis because of the maturity of the MIR technology, the enormous interest in it, and the many different applications ("fields of use") that it has. MIR will significantly influence products such as burglar alarms, appliances, toys, robots, vending machines, and healthcare equipment.

Small Business Program. With support funding from DOE Defense Programs Small Business Initiative, we established a Small Business Program in November 1993 to help small companies (those with 500 or fewer employees) overcome technological barriers by providing them access to Laboratory resources. To date LLNL has assisted over 200 small businesses with a broad range of help, including technical consultation, technical information, access to specialized or unique equipment, and education and training activities.

Many small-business requests involve evaluating and/or testing materials, computer software, fabrication processes, or diagnostic instrumentation. For example, using our years of fabrication and welding expertise developed in the weapons program, we identified the cause of microfissures in arc-welded stainless-steel tanks for a New Jersey firm. A California company asked for our help in testing its video-conferencing software over large local-area networks via digital phone systems. Our assistance to a Utah manufacturer of beryllium windows (used to detect soft x-rays) allowed the firm to market its product sooner than expected.

Partnership agreements with small businesses take a variety of forms, including Small-Value CRADAs (originally Small-Business CRADAs), technology licensing, and user facility agreements. Small-Value CRADAs are the most common means of partnering. They are short-term agreements—typically less than six months—and our contributed effort is limited to $50,000. LLNL has entered into more than 36 Small-Value CRADAs, spanning an array of technological challenges, ranging from rapid-growth

crystals for use in optical lenses, which is vitally important to our laser program, to airbag enhancements in vehicle safety systems. And like all other CRADAs, no public funds go to our industrial partners in any of these relationships.

One of the Laboratory's first small business partnerships was with a small California firm that had designed a new type of clutch. LLNL helped the company demonstrate through test data comparisons that the clutch could meet the requirements of one of the major U.S. automakers. According to the firm's president, "The Lab provided us with more than we could have ever hoped for. The quality of the work performed was remarkable and the whole team was very responsive to our needs. Also, the fact that LLNL was conducting the tests carried a lot of weight..."

HOW THE PROCESS OF FORMING PARTNERSHIPS WORKS AT LLNL

The mechanisms we use in Industrial Partnerships include Nondisclosure Agreements, CRADAs, Work-for-Others Agreements, Licensing Agreements, Small-Value CRADAs, Technical Assistance Agreements, the National Machine Tool Partnership Consulting Agreement, User Facility Agreements, and Personnel Exchange Agreements. The use of each of the mechanisms requires negotiations between LLNL and the prospective partner. Our Industrial Partnerships and Commercialization organization was established to carry out the process.

Licensing as an Example of the Partnership-Forming Process

Laboratory researchers file about 260 invention disclosures yearly. Once the licensing staff at LLNL is convinced there are sizable commercial possibilities for a patented (or patent-pending) Laboratory invention, they issue a public announcement to contact potential licensees. Interested firms are invited to LLNL for preliminary discussions. These discussions are held under mutual nondisclosure agreements so the company cannot use any information the Laboratory divulges about the technology. Likewise, the Laboratory cannot share any information it learns from a prospective licensee.

Interested firms provide the Laboratory preliminary marketing and business-plan information. Our licensing specialists scrutinize projected pricing data, sales estimates, profit margins, marketing campaigns, distribution networks and production schedules. The company or companies chosen to receive a license are not necessarily the largest firms competing but the ones LLNL licensing specialists believe will be the most successful at bringing the new product to market quickly and marketing it effectively.

The final step is drafting a licensing agreement. Milestones in the company's business plan are often part of the provisions of the license so that a company that unreasonably delays bringing the product to market risks having the Laboratory revoke its license. Domestic commercialization of technologies is a priority consideration and the license and royalty fees we negotiate are based on common industry practices. There is no standard royalty structure; it depends on the product, the market, and other relevant business considerations.

CRADAs as an Example of Improving the Partnership-Forming Process

The DOE and its laboratories are involved in a continuing effort to improve the timeliness and flexibility of the process for developing, approving, and executing CRADAs. The changes introduced to the process, at the national and the local levels, are heavily influenced by lessons learned from previous CRADA experiences and feedback from Industrial Partners. The goal of the continuing process improvement is to better serve prospective Industrial Partners, for whom time is money in a competitive marketplace, and the DOE programs who share the dual benefits derived from the cooperative efforts.

At the national level, DOE introduced the "Modular CRADA" concept to enhance flexibility and the "Small-Value CRADA" (originally the Small-Business CRADA) to reduce the time and effort involved in the process. The Modular CRADA concept allows an Industrial Partner to tailor the terms and conditions of the agreement to better meet its needs by selecting from a collection of "modules" that have been pre-approved by DOE. In addition, DOE has recently established a well-defined, streamlined process for completing complex, multi-laboratory cooperative agreements. DOE is continuing to explore ways to further simplify the language in some of the more complex CRADA modules and incorporate some of the positive aspects of the Small Value CRADA into the standard CRADA process.

DOE has also streamlined the CRADA approval process by introducing the concept of a "generic" (fill-in-the-blank) Joint Work Statement with fixed time commitments for approvals and is working on a new "short form CRADA" which takes advantage of some of the positive aspects of the Small-Value CRADA for straight-forward, large-value agreements.

At the local level, specialists from LLNL and the DOE Oakland Field Office meet regularly to explore means to further simplify and implement these processes for completing cooperative agreements with industry.

As a result of all these actions, a CRADA which took 18 months to execute in 1991 now at times can take less than 90 days, from start to finish.

THE TECHNOLOGY TRANSFER IMPROVEMENTS ACT OF 1995

Your Committee's efforts to improve and refine the laws governing Technology Transfer between Federal laboratories and the private sector are important because of Findings 1 and 2 in Section 2 of your proposed bill. We heartily agree that:

> "Bringing technology and industrial innovation to the marketplace is central to the economic, environmental, and social well-being of the people of the United States."

and that:

> "The Federal Government can help United States business to speed the development of new products and processes by entering into cooperative research and development agreements which make available the assistance of Federal laboratories to the private sector, but the commercialization of technology and industrial innovation in the United States depends upon actions by business."

We also agree with the overall intent of the proposed Technology Transfer Improvements Act of 1995 to improve the commercialization process. However, we have some specific concerns that stem from language pertaining to the granting of exclusive licenses, which needs clarification and qualification. I will elaborate on this issue. In addition, our Industrial Partnering and Commercialization staff at the Laboratory have noted a few minor inconsistencies and other issues that merit attention, particularly the absence of Government march-in rights due to lack of diligence in commercialization. They are more than willing to discuss their specific recommendations with your staff.

Regarding the granting of exclusive licenses, a clarification is needed in Finding 3 in Section 2 because there is a distinction between Federal Laboratories and national laboratories such as LLNL. It is currently much more difficult for Federal laboratories to grant exclusive licenses than national laboratories. At LLNL, we are able to—but rarely grant—an exclusive license for all fields of use. However, we often grant an exclusive license to a company in its field of use (i.e., limited exclusive license) when it is the best way to commercialize a technology.

Unless the exclusive licensee agrees, a laboratory that issued an exclusive licence cannot do further reseach on that technology under a CRADA or Work-for-Others agreement with another company even though the second

company may be in an entirely different business than the first company. Exclusive licensing bars opportunities for other companies (unless granted sub-licenses) and prevents products from being developed in fields of use outside that of the licensee. In short, exclusive licensing in many instances is counter to the technology commercialization goal.

Accordingly, we believe some qualification is needed in the language in Finding 3 in Section 2 and in Section 3 (b) (1) to ensure the broadest application of the technology. The most appropriate licensing arrangement (exclusive, limited exclusive, or non-exclusive) depends on the technology's maturity, the scope of potential applications, and the need for exclusivity to ensure commercialization.

I support a clarification of Finding 3 that "commercialization of technology and industrial innovation in the United States will be enhanced if companies, in return for reasonable compensation, can more easily obtain exclusive licenses to inventions in their field of use when exclusive licenses are needed to ensure commercialization."

I also recommend that the language in Section 3 (b) (1) read "The laboratory shall ensure that the collaborating party has the option to negotiate under reasonable terms and conditions a type of license in a field of use that best assures commercialization of such invention under the agreement or, if there is more than one collaborating party, that the collaborating parties are offered the option to hold licensing rights that collectively encompass the rights that would be held under such a license by one party."

These suggested changes would provide both parties flexibility to negotiate agreements that fit the particulars of the circumstances. Although the entire process of Industrial Partnering for LLNL is still quite new, we have gained much valuable and relevant experience in the last three years and have found that flexibility in dealing with our private sector "customers" is essential. The Laboratory strives to provide fairness of opportunity through widespread notice of licensing opportunities and fair access to those opportunities. We also strive to select companies that have the capability and drive to commercialize our technologies. We work very hard to provide companies the license that will give them the highest probability for success and assure us that the technology will be commercialized. That license is not always an exclusive license.

In most cases, we grant limited exclusive (i.e., field-of-use) licenses. These licenses are appropriate when a technology still requires considerable R&D and significant risks remain in terms of the amount of funding and time it will take to get a product to market. Most technologies at a federal laboratory are in this category.

Our electromechanical battery technology is an example of limited exclusive licensing. This technology is the subject of two CRADAs for two very different applications: powering vehicles and stabilizing the output of electric power supplies. In a car, the flywheel battery would capture and store energy otherwise dissipated during braking for later use to power quick accelerations. In the other CRADA, LLNL's flywheel battery is being used to help ensure power quality at factories, computer centers, and other facilities that have sensitive computer chips in important electronic control and processing equipment. For each application, we granted our CRADA partner a limited exclusive license.

In other cases, when a technology is advanced and ready for market, it makes sense to provide licensing opportunities to several companies who each can put their resources behind commercializing the technology. Many companies are very supportive of non-exclusive licenses in these instances. Such is the case for the Micropower Impulse Radar technology that I discussed earlier.

CLOSING REMARKS

Industrial Partnering works. It makes sense for the Laboratory and for U.S. companies. We benefit from forming partnerships selectively with industries to support and enhance our programmatic efforts to meet important national needs. At the same time, American industries can tap into our cutting-edge technologies, capabilities, and facilities to bolster their competitiveness in the global marketplace.

In recent years, LLNL has stepped up its efforts to form Industrial Partnerships and has made a concerted effort to provide fair access to opportunities. Our Industrial Partnership and Commercialization office publicizes information about LLNL's scientific and technical capabilities, technologies available for licensing, small business programs, and how to do business with the Laboratory. We work with potential partners to understand their needs, their business goals, and their capabilities, and how we can work together. Then we negotiate on a case-specific basis to establish an equitable partnership arrangement. Our aims are to meet programmatic R&D needs, to foster commercialization of technologies we have developed, and to preserve our ability to pursue R&D opportunities outside the specific field of use being considered in a partnership.

I anticipate that Industrial Partnering relationships will continue to flourish because of the laboratories' strengths. LLNL and the other DOE multiprogram laboratories conduct multidisciplinary R&D on large, complex problems that frequently are high-risk and have long time horizons. Our

work, along with university research, which is largely conducted by individual investigators motivated by scholarship, complements industry's needs. Industrial research, by comparison, is strongly influenced by near-term market forces. Industrial Partnering combines these diverse strengths so we can meet our research goals more cost-effectively and help ensure that technology and industrial innovation flows back into the domestic economy to the benefit of taxpayers who support our efforts. We believe that Industrial Partnering will continue to be an important part of our Laboratory and a good investment in the future for all Americans.

Mr. SCHIFF. Thank you very much, Mr. Cochran.
Mr. Marczewski.

STATEMENT OF RICHARD MARCZEWSKI, MANAGER, TECHNOLOGY TRANSFER OFFICE, NATIONAL RENEWABLE ENERGY LABORATORY

Mr. MARCZEWSKI. Thank you, Mr. Schiff. I'm honored to have been invited to represent the National Renewable Energy Laboratory at these hearings here.

In listening to the questions and discussions that have gone on in the first panel, and reading the legislation that Mrs. Morella proposes in the Technology Transfer Improvement Act of 1995, a lot of the discussion centers around CRADAs.

And what are CRADAs? They're a mechanism that was invented to bridge the gap between what industry needs and what the laboratories have developed. And the mechanism was created to overcome a roadblock that's in the way there.

And if you'll allow me a quick metaphor here, describing technology transfer in the simplest forms, on the one hand you've got a restauranteur who's interested in making and selling omelets. On the other hand, you've got a farmer. The farmer and the restauranteur get together. The farmer gives the restauranteur the chicken. Do you have omelettes? No. You've got chickens.

The situation is much the same in our laboratories. We've got restauranteurs that come to us. We give them chickens. Are they in a position to sell omelettes? No, they're not. So what happens in the middle, between the transfer of the technology, the chicken, and the value that it provides, the omelette that the restauranteur can sell? That's tech transfer.

Now, we at the National Renewable Energy Laboratory are looking at a lot of mechanisms. A CRADA is just one mechanism to overcome the barriers that we have in dealing with the movement of these kind of technologies.

We're looking at the opportunity to spin off technologies, either an individual technology through licensing agreements. Could it be the possibility of spinning off an entire department, or a group of our individuals who are working on specific technologies that are beginning to approach maturation, that are ready to be spun off as companies?

Could it be through joint ventures? Could it be through opportunities in working with venture capitalists to form brand new companies, to add value, to make those omelettes, so to speak?

We're going to be looking at aggressively doing work for others, contract kind of research. Does it make more sense, since we've assembled some of the brightest minds in the world with regards to energy, efficiency, renewable energy, biomass kind of energy.

Let us use that resource to the best of our abilities. We're going to be looking at licensing the technologies that we have in a much aggressive fashion. We're looking at opportunities in foreign markets through foreign patents, and we're looking to do this in an environment in which we're having ever-shrinking funding, with the concern of not dismantling the core competencies that have been assembled in that laboratory over the past two decades.

And we're going to be asking you folks, through the legislative process, to allow us, both as NREL and the other government-funded laboratories, to use the best business practices in running our business.

We're in the business of technology. We'd like the opportunity to deliver on that technology.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Marczewski follows:]

Testimony of Richard Marczewski

Manager, Technology Transfer Office
National Renewable Energy Laboratory

Regarding the Proposed Technology Transfer Improvements Act of 1995

Before the
U.S. House of Representatives
Committee on Science

Subcommittee on Basic Research and
Subcommittee on Technology

June 27, 1995

Introduction

Thank you for this opportunity to comment on these proposed amendments to the Stevenson-Wydler Technology Innovation Act of 1980 and on technology transfer activities at the National Renewable Energy Laboratory (NREL). NREL views technology transfer as central to the overall success of its research mission and greatly appreciates your interest in our comments on this proposed legislation regarding cooperative research and development agreements.

NREL firmly believes that it is in the nation's best interest to move technologies into the competitive marketplace in an expeditious manner. NREL uses cooperative research and development agreements, Work For Others agreements, patent licensing, and other innovative technology transfer mechanisms to develop and transfer technology to American industry. We fully support the general thrust of this Committee's work to provide greater flexibility to Federal agencies and laboratories to more efficiently apply these mechanisms.

Comments on the Technology Transfer Improvements Act of 1995

Page 2: Lines 18 - 20 ; Section 2, paragraph 3

This bill proposes to make it easier for private companies to acquire exclusive licenses for technologies developed jointly with government laboratories. Exclusivity is frequently essential for mobilizing the resources necessary to bring a technology to commercial fruition to the benefit of the nation, and we believe that exclusive licenses would greatly accelerate commercialization in these cases. There are other cases, however, such as fundamental "gating" technology breakthroughs, when such exclusivity might be anti-competitive and disadvantageous to the nation's best interests.

Recommendation - Care should be taken that provisions of the bill pertaining to granting of exclusive licenses retain for the Government the ability to choose not to grant an exclusive license, if this would not be the most effective means to commercialize the technologies. In the case of government-owned government-operated (GOGO) laboratories, that prerogative would rest with the administering agency. In the case of government-owned contractor-operated (GOCO) laboratories such as NREL, that prerogative should rest with the contractor operator.

Page 3, line 11 ; proposed new Section 12 (b)

It is possible that an invention made in part by a Lab employee in an area covered by a CRADA was first conceived and/or reduced to practice as part of separate work outside of the CRADA. A CRADA collaborating party should be given a patent licensing prerogative on an invention made "in part" by a laboratory employee only if all of the other inventors are also parties to the cooperative agreement.

Recommendation - These provisions should apply only to inventions made specifically as part of the CRADA work. Advances, even in an area covered by a CRADA, should not be subject to these provisions if the advances were accomplished outside of the CRADA.

Page 3, Lines 13-20 ; proposed new Section 12 (b)

The bill as currently written allows the collaborating party to choose to receive an exclusive license for a field of use for any invention made in whole or in part by a laboratory employee under the CRADA. This unreasonably restricts the laboratory from objectively defining criteria under which a nonexclusive license is preferable and advantageous to the technology's commercialization. For example, an exclusive license on a fundamental breakthrough technology may be anti-competitive and actually hinder the efficient workings of the competitive market. As another example, if the collaborating party does not have the necessary resources to commercialize, then granting an exclusive license would decrease the potential for expeditious commercialization and marketing of the invention. As a third example, if the collaborating party is or becomes a foreign-owned entity, it may not be in the best interests of the United States to have the invention exclusively controlled by that foreign-owned entity.

Recommendation - Do not give the collaborating party sole or decisive authority to select an exclusive license. Allow the Federal agency (for GOGO) or contractor operator (for GOCO) to set guidelines for when different types of licenses are most appropriate and effective.

Specifically address the rights of foreign and foreign-owned entities by providing to the federal agency or contractor operator the power to select an appropriate license that would protect the United States' economic interests.

In line 15 on page 3, change "a field of use" to "the field of use identified in the cooperative research and development agreement" in order to suitably limit this right.

Page 3, line 24 to page 4, line 8 ; proposed new Section 12 (b) (1) (A)

The first sentence refers only to a single collaborating party though a CRADA may include more than one collaborating party. The first sentence also states that the license is given to the laboratory; it is more appropriate for the license to be given to the government.

The section does not address the time constraints on protection of proprietary information. Currently, the protection afforded by statute for CRADA's is for five (5) years from the generation of the data. In so much as commercialization may require three or more years after the successful completion of the cooperative research and development project, data should be protected for a longer time period.

Notwithstanding commitments to keep confidential the privileged or confidential information of its collaborators, the Government realistically needs rights to use enabling background technology necessary to reasonably practice the subject technology.

Recommendation - The bill should refer to "collaborating party or parties" since there may be more than one party involved in the cooperative research and development project.

The license should be given to the Government rather than to the individual laboratory so that the Government can delegate the right to practice the technology on its behalf to any of its laboratories or other entities.

The time frame for protection of data should be expanded from the current five years from generation of the data to "five (5) years from the completion of the cooperative research and development agreement."

It should be specified that the provisions for protection of data do not preclude the Government from using background technology necessary to practice or to have practiced on its behalf, the subject technology for governmental purposes.

Page 4, line 9 to page 5, line 7; proposed new Sections 12 (b) (1) (B) and (b) (1) (C)

The intent of this section seems to be to ensure that a collaborating party commercializes the technology in a timely and suitable fashion. However, the current language does not include any method to exempt a well-performing collaborating party from licensing its direct competitors. Other legislation governing intellectual property exempts the collaborating party from licensing if it is meeting, or in a reasonable time will meet, market demand. Without this exemption, prospective collaborating parties will be discouraged from participating in these types of agreements.

The language of the draft bill does not grant that such licensing should provide reasonable royalties to the collaborating party.

Recommendation - Include an exemption from licensing in a company's own field, if the company (i.e., collaborating party) or its sublicensees are fulfilling, or will within a reasonable time fulfill, U.S. market demand.

Make sure that these provisions do not restrict the Government's basic rights to "march in" and take control of a license in the event the licensee is not furthering the public interest.

Add language ensuring that the collaborating party receives reasonable royalties for such licensing.

For clarification, in line 14 on page 4, change "license" to "sublicense"; and in line 15, change "licensed" to "sublicensed".

Consider whether these intellectual property protection provisions should be limited should the collaborating party's ownership or location move out of the United States.

Page 5, lines 12-22 ; proposed new Sections 12 (b) (2) and (b) (3) (A and B)

Private funds should not be managed like appropriated funds. While the bill allows a Federal agency or laboratory to accept, retain and use funds (as well as personnel, services, and property from a collaborating party), it does not provide that the use of such funds should be considered as an expenditure of private funds. These funds should be considered private funds that can be expended using best commercial practices rather than Federal funds subject to the restrictions imposed by, for example, Federal Acquisition Regulations. This would improve the effectiveness and efficiency of conducting research under cooperative research and development agreements.

Recommendation - Clarify that funds obtained from collaborating parties are not Federal funds and therefore can be expended by the Federal agency or the laboratory using best commercial practices rather than Federal Acquisition Regulations. (Appropriate legislation may be required to enable the Federally-funded laboratory to so use such funds.)

Page 5, line 23 to page 6, line 4 ; proposed new Section 12 (b) (3) (C)

The exact intentions of this subsection are not clear. We understand this subsection to mean that an employee inventor is not automatically precluded from participating in a commercialization venture. We agree that the inventors' participation in a commercialization process is advantageous, but we believe that it is essential that the Lab be able to define clear guidelines for such participation in order to avoid any potential for conflicts of interest or questions of fair play.

Recommendation - Revise this section to better clarify the desired intent.

Revise this section to explicitly empower the Federal agency or contractor operator to define and implement policies necessary to provide opportunity for inventors to participate in technology commercialization while assuring proper attention to issues of conflicts of interest and fair access.

Page 6, lines 9 to 20 ; proposed new Section 12 (b) (5)

This section refers to the methods by which a government-owned, contractor-operated laboratory may use royalties or other income accruing to the laboratory under a cooperative research and development agreement with respect to inventions. The use of such royalties or other income should not be limited by the federal agency.

Recommendation - Expand this section to allow royalty payments or other income to be used by the laboratory for maintaining and enhancing its core competency, for providing incentives to privatize commercially viable technologies, and for aggressively seeking out partners to advance, commercialize, and market its capabilities and inventions. (Appropriate additional legislation may be required to enable the Federally-funded laboratory to augment its funding by so using royalties and other income derived from the licensing of its inventions.)

Technology Transfer Activities at NREL

As provided in your invitation to testify, I would now like to discuss technology transfer generally. I was recently named as manager of the NREL Technology Transfer Office staff of six persons. I come to the job with management experience in the external technologies' group at General Motors and in NREL's hybrid vehicles program. I would like to share with you NREL's thinking about traditional technology transfer methods and about some of the new tools we are planning to use.

NREL firmly believes that the expeditious transfer of technology to American industry is essential to the overall success of its research mission. We view technology transfer as an integral element of NREL's in-house research programs and as a key goal of cost-shared, industry research subcontracts. As an example, we are already well along in the process for negotiating licenses for both of the NREL technologies that recently received prestigious R&D 100 awards.

Information Sharing, Patent Licensing and Cost-Shared Subcontracting

The traditional focus of technology transfer at government laboratories has been information dissemination and, in recent years, patent licensing. NREL is active in these traditional technology transfer mechanisms, and is reasonably successful at applying these methods.

Information dissemination occurs by NREL personnel participating in technical conferences, publishing journal articles, exchanging lab visits with industry researchers, and hosting research review meetings. The value of these information dissemination efforts is sometimes clearly visible (as when specific lab processes are handed off to industry, with subsequent patent licensing as appropriate) and at other times is less so (as when NREL's research insights are incorporated into industry's proprietary materials or processes). The Technology Transfer Office contributes to this information dissemination by helping to organize and implement the various publications, meetings and visits through which the personal contacts between researchers are made.

Patent licensing is generally an outgrowth of the information dissemination process. Industry research partners typically evaluate NREL advances by preliminarily incorporating the advances into their proprietary experimental technologies. Patent licenses are negotiated as appropriate.

To date NREL has granted six patent licenses and is in final negotiations on another three. One noteworthy example is our advanced aerodynamic design for airfoils that can increase the efficiency of wind turbines by as much as 30%. This gain in efficiency makes wind energy competitive with conventional base-load electrical generation in many areas. These advanced designs allow efficiencies to remain high at the lower wind speeds typical of the Great Plains where there is in principle sufficient wind energy potential to meet the electrical needs of the entire country. We have licensed the airfoil design to three wind

turbine companies and have agreements pending with two others. Upgrading currently operating wind turbines in the United States with advanced airfoils would generate additional electricity worth approximately $30 million per year.

A general issue related to patent licensing that deserves consideration is the availability of exclusive licenses to patents owned by DOE. Patents to NREL inventions prior to 1984 are held by DOE, and potential licensees have experienced long (e.g., 2 - 3 years) delays waiting for DOE waivers of patent rights to NREL, without which there can be no exclusivity to their licenses. Guidelines for when exclusive patents are appropriate (and conversely when not appropriate) should be better defined. Where legislation does not already do so, new legislation should be enacted to encourage agencies to waive patent rights to GOCO's where there is good opportunity to commercialize a technology if some degree of exclusivity can be granted.

Another general issue related to patent licensing is the expense of obtaining foreign patents. Initiatives aimed at streamlining international patent protection would strengthen the commercial value of Lab innovations.

The Technology Transfer Office broadens NREL's impact beyond its established research partners by publicizing technologies available for transfer. Various marketing publications are distributed, and we host or attend an assortment of technology transfer forums. Information on licensable technologies was recently posted on the Internet. These publications, meetings and electronic communications are simply sophisticated tools used to accomplish fairly traditional technology transfer techniques.

NREL is in the process of revising some of its traditional technology transfer policies. We are developing new guidelines to streamline the decision-making on licensing terms. For example, while we recognize the competitive market advantages that accrue to any single grantee of an exclusive license, we are concerned about balancing industrial access to government-funded technology and about maximizing the likelihood of a technology advancing to commercial production where it can materially benefit the nation. Simply put, we are developing guidelines to help speed the decision making process between the myriad licensing choices possible.

Another example of NREL's recent rethinking of traditional technology transfer methods is the complex issue of employee innovation rewards and commercialization participation. It is often desirable for the inventors of a new technology to participate in that technology's progression to commercial fruition. It's often been said that the best vehicle for technology transfer is the physical transfer of knowledgeable people. Industrial licensees are of course free to recruit NREL experts to join their private enterprises, and/or to seek ongoing interactions through, for example, CRADA agreements. However, one must be mindful of potential conflicts of interest and fair play (e.g., access of industrial competitors to the Lab's government-funded research). We are currently reviewing our policies for opportunities to facilitate accelerated transfer of technology to American industry while maintaining the highest standards of equal access and fair dealings.

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Broadly viewed, NREL's cost-shared research subcontracts with its industry partners are another element of traditional technology transfer in that the subcontracted research often incorporates close interactions between NREL and industry researchers. These subcontracts could be made more efficient and cost effective. In subcontracting and in general Lab operations, a move to well-established business management practices would benefit both the researchers and the funding sources. NREL is currently moving to adopt best commercial practices to improve its operation.

CRADA's and Work for Others

One inherent limitation of traditional technology transfer techniques is that basic research and development seldom advance a technology near to commercial readiness. The advent of cooperative research and development agreements (CRADA's) and Work for Others (WFO) agreements have allowed Lab researchers to narrow the gap between their scientific research and industry's developmental engineering.

NREL has been active in forming CRADA's since the inception of the NREL Technology Transfer Office in 1990. We signed our first CRADA in 1991, and now have 33 CRADA's encompassing over $ 70 million of research work funded 27% by Federal monies and 73% by industry investments. One third of those CRADA's are with small businesses. We are currently negotiating 18 more CRADA's. Our first CRADA was with New Energy Company of Indiana to use our technology for producing ethanol from cellulosic biomass to augment the overall efficiency of their existing production of ethanol from corn. The success of that work led to a second CRADA that expands upon that work. Another notable CRADA with AlliedSignal Corporation is using NREL's technology for recovering base polymers from mixed plastic waste to recycle nylon carpeting.

CRADA's have been effective at accelerating the transfer of the results of NREL's research to American industry. However, there are certain structural limitations. For example, year-by-year funding of DOE programs requires year-by-year funding of in-house research in support of CRADA's. The inherent uncertainty of year-by-year funding hampers the securing of the sizable long-term investments that industry collaborators must commit for their shares of CRADA programs.

Another area of concern now being reviewed by NREL management is the ownership of intellectual property related to a CRADA. Clearly the industry collaborator should have first rights to commercialize any intellectual property that originates from Lab-industry collaboration under a CRADA. However, additional attention must be directed at issues of pre-CRADA "background" intellectual property (e.g., developed and owned by the Government, and necessary to effectively use the CRADA advances). Similarly, in line with our reexamination of patent licensing guidelines, we are reexamining how any given CRADA should be defined so as to not inadvertently block research, development and industrial commercialization of different, but related, technologies.

Work For Others agreements allow the Lab to accept funds from an industry collaborator to do specific projects for that industry collaborator. NREL has had limited experience in using Work For Others agreements, but we anticipate significant additional use of these agreements as we "market" the Labs expertise as part of our efforts to obtain innovative sources of income. WFO agreements provide an opportunity to cost-effectively leverage the nation's past investments in Lab science talent and facilities. However, WFO agreements are at present saddled with several complicating requirements that this Committee should consider addressing. For example:

- WFO agreements require case-by-case government approval and detailed documentation that the work could not reasonably be done elsewhere. The approval process is often cumbersome and can significantly delay the start of a project. A streamlined approval mechanism that defines guidelines and empowers the Lab to enter into appropriate WFO agreements would simplify the use of this funding / technology transfer tool. Laboratories should be empowered to enter into agreements based on sound commercial logic, namely whether the proposed project: (1) supports its mission, objectives and long-term plan; (2) supports, maintains or expands its core competencies; (3) furthers the economic, environmental and social-well being of the nation; (4) can be accomplished without interference of its prime contract's mission and objectives; and (5) creates opportunities for additional revenues as a result of potential marketing or commercialization activities. Laboratories should be allowed the flexibility to simply document that the agreement is in the best interests of the laboratory and does not interfere with its responsibilities under its contract with the Government.

- WFO projects currently must follow government acquisition rules intended to regulate the expenditure of government funds. Two of the biggest impediments to WFO projects are the advance payment and overhead payment requirements. Current regulation of WFO's makes no distinction between private funds paid to the Lab (e.g., as compensation for use of government facilities and equipment) by the collaborating party and appropriated funds provided to the Lab. Thus, private funds provided under a WFO are burdened with full government acquisition regulations. Such WFO funds from private sources should be handled by regular business practices.

- WFO agreements funded by industrial collaborators should by accompanied by greater latitude to the Lab in negotiating intellectual property rights and license fees that arise from such funds-in work.

- When a project is funded by a WFO Agreement or CRADA collaborating party and certain items (e.g., experimental equipment or materials) are provided to the Lab for use in the research under the agreement, then such items should not *ipso facto* become government property controlled by Federal Property Management Regulations. The laboratory should be free to use and dispose of such collaborating-party-provided items as they determine to be most appropriate.

Spin-Out Ventures

NREL is working to define new innovative methodologies for transferring technology to industry and for earning a better return on the taxpayers' investment in renewable energy. One such innovation is the use of "spin-out ventures" in which NREL's more mature technologies could be spun-out to privately-capitalized, stand-alone business ventures.

Our intent is to transfer NREL's more mature technologies to private industry by handing off integrated technology programs as the core of new business ventures. Our preliminary investigations indicate significant interest in funding and operating such enterprises from the venture capital sector. New ventures of this sort appear better suited to lead to expeditious commercialization of these new technologies than do continued laboratory research or to grant traditional technology licenses.

We are investigating as a first step the spin-out of NREL's Biofuels Program. The Biofuels Program has developed innovative technology for converting cellulosic biomass to ethanol and other useful fuels and industrial chemicals. NREL (through its operating contractor, the Midwest Research Institute (MRI), which is a not-for-profit organization) holds key patents in this technology.

The management structure of spin-out ventures could take many forms. We anticipate that a biofuels venture would be supervised by a board of directors that includes representatives of MRI, DOE's alternative fuels program, venture capital financiers, and NREL's strategic partners in the transportation and biofuels industries. One possible mechanism for overall management might be a holding company to capitalize and oversee the individual spin-outs as well as joint ventures between NREL and existing companies.

One important consideration in this arena is the proper balance between the broad information dissemination that characterizes traditional technology transfer and the information protection that provides exclusivity for competitive advantage. Just as CRADA's require greater protection of information to give the industry collaborators a competitive advantage for their investment, the creation of spin-out ventures requires a careful consideration of the proper stewardship of the public investment in renewable energy technology. NREL is confident that spin-outs and joint ventures can be set up that optimally balance public interests in fair access with private interests that are at play in accelerating effective technology transfer and commercial exploitation.

There may be administrative concerns associated with the formation of spin-out ventures that require regulatory or legislative facilitation. The spin-out paradigm promises to respond to calls for improvements in the nation laboratories' operations in a way that is responsive to recommendations such as those of the Galvin report for more businesslike operation while capitalizing on the labs' strengths and giving a solid return on the nation's investment.

Broad Reexamination of Technology Transfer

NREL's reexamination of its policies and priorities in traditional information dissemination and patent licensing, in CRADA's and Work For Others agreements, and in spin-out venture formation are complementary elements to a broad reexamination of cost-effective technology transfer methods. The goal is to create a low cost, revitalized, integrated set of methods to efficiently transfer technology. Among other activities, we are initiating a quarterly NREL Enterprise Growth Conference in July to assist our industrial partners in launching their businesses. These conferences will include expert panelists from the venture capital and financial community with interests in the opportunities presented by renewable energy and related technologies. In particular we will be addressing many of the technologies researched by NREL and approaching commercial readiness.

Related issues under review at NREL are the establishment of technology transfer leaves of absence for NREL employees, the revision of reward programs aimed at encouraging marketable innovation, the consideration of technology transfer in long-range program planning, and the implementation of a sunset review process to better allocate resources between research programs.

To elaborate briefly on one example, we are developing a "sunset review" process to more concretely establish milestones and criteria for technology development. These milestones and criteria will allow us to more readily and objectively identify maturing technologies ready for spin-off to private industry, languishing technologies no longer deserving of Lab funding, and viable technologies that have evolved away from NREL's core mission and that should be transferred to other Labs or entities. We will use this process to review our projects and make appropriate recommendations to DOE.

Restrictions on Retention of Income

One last area I would like to highlight is the existing limitation on income that national laboratories can obtain from non-government sources. As NREL moves to identify innovative income sources and aggressively spin-out technology to industry, these limitations will impose a significant and detrimental constraint, and will hamper the Lab's effort to fulfill the priority core of its mission at the lower Federal funding levels being discussed today.

Current restrictions on government-owned, contractor-operated laboratories limit the amount of income (e.g., from patent license fees and royalties) that a laboratory may retain to 5% of its current fiscal year budget. If royalties exceed 5% of the fiscal year budget for the laboratory, then the laboratory is allowed to retain only 25% of the "excess" royalties, with the balance paid to the Treasury. This severe limitation on income is a strong disincentive for obtaining innovative Lab funding via non-government revenue sources such as patent royalties, CRADA's or Work For Others Agreements.

We encourage you to consider legislation that allows laboratories to broaden their funding by aggressively seeking to tap into new revenue sources to augment their Federal funding. The current limitations on augmenting funding and retention of income should be eliminated. The removal of these limitations would require appropriate legislation.

Closing Comments

Thank you very much for this opportunity to comment on the proposed "Technology Transfer Improvements Act of 1995" and to share these general thoughts on improving technology transfer.

It is clear from the sharply lower budget allocations proposed for technology transfer in FY 1996 that the Congress is concerned about the value and wisdom of DOE technology transfer activities. We at NREL understand the reluctance to fund any activity that might appear to be an inappropriate intrusion of Federal funding into the commercial investment arena of private industry. We believe that we have carefully targeted NREL's research programs and its Technology Transfer Office at securing maximum leverage of the nation's modest investment in renewable energy research while avoiding any such interference in the competitive marketplace.

NREL serves as the nation's premier center of excellence in renewable energy technologies. We believe that the development and implementation of advanced renewable energy sources are of key importance to our nation's long-term security, prosperity and well-being. NREL is implementing improvements to its operations to enhance its efficiency, to seek innovative funding sources, and to cost-effectively and more rapidly transfer its technology to American industry.

Mr. SCHIFF. Thank you, Mr. Marczewski.
Dr. Lyons?

STATEMENT OF DR. PETER B. LYONS, DIRECTOR, INDUSTRIAL PARTNERSHIP OFFICE, LOS ALAMOS NATIONAL LABORATORY

Dr. LYONS. Thank you, Mr. Chairman.

At Los Alamos, we view our key central mission, the key central focus for our laboratory, as reducing the global nuclear danger. And we see that central mission as having many, many components ranging from stockpile stewardship, stockpile integrity, environmental, and nonproliferation aspects. And at the same time, we see increasing challenges at the laboratory in terms of how we can accomplish that mission, everything from no nuclear testing to possible remanufacturing requirements for the stockpile, and certainly tightly constrained budgets.

We see at Los Alamos that we simply are in a time when it is absolutely essential that we utilize the best sources of science and technology available to us nationally. It is from that statement that we derive the tremendous importance of involvement in industrial alliances with a wide variety of types.

We view those alliances as providing access and knowledge of the best practices, the technologies, that industry has developed. We look at those interactions as allowing us to maintain and enhance core competencies that are required in our central mission. And finally, we look at those alliances as critical in maintaining the excellence of our scientific and our engineering staff.

My colleagues have already spoken to the importance of having a variety of mechanisms to having flexibility in mechanisms that can be used in different industrial alliances. I would only second those comments. Certainly the CRADAs have been an extremely important mechanism. We've used it effectively at Los Alamos, and at many other laboratories, and in concert with the department, as well as through work at the laboratory.

We've dramatically reduced and shortened the time required in order to effectively get CRADAs in place. Many of the early concerns with the burdens and nature of CRADAs have largely been put behind us. Our record now on a CRADA is 15 days, and we'll probably still improve on that.

I don't mean to say that CRADAs can't be improved. They certainly can be. And I think that the bill that Congresswoman Morella has proposed will further improve the CRADA mechanism.

But I do hope that the Committee recognizes the importance of the CRADA mechanism, and some of its very important features. Perhaps the most important is that it truly represents an opportunity for leveraging the investments of the taxpayers from the perspective of the missions that they require of national laboratories, and leveraging the dollars that industry has put in to developing their science and technology base.

CRADAs we view as an extremely effective leveraging opportunity, and they are definitely anything but a grant program to industry.

Let me also just mention that one of my largest concerns involves the future of the so-called Tech Transfer Initiative within defense programs, which has been used at Los Alamos and some of the

other primarily DP laboratories to support the largest fractions of the CRADAs underway at Los Alamos.

We are in the process of trying to refocus and successfully refocusing the TTI program more directly on Department mission needs. But we're faced with a situation now that, if the TTI program is cut drastically just at the time when we believe we need industry in order to accomplish our mission, a cut in the TTI program could lead us to cancel large numbers of partnerships already existing within the national laboratory.

That runs the risk of branding the laboratory as an unreliable partner to industry. And just at the time we see these partnerships and alliances as being critical, we have the potential of branding the Department and the laboratory, the government, as being an unreliable partner with industry. And that, we've very concerned about.

Thank you. I look forward to your questions.

[The prepared statement of Dr. Lyons follows:]

TESTIMONY TO JOINT HEARING ON TECHNOLOGY TRANSFER

U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON SCIENCE

SUBCOMMITTEE ON BASIC RESEARCH
CHAIRMAN
STEVE SCHIFF

SUBCOMMITTEE ON TECHNOLOGY
CHAIRWOMAN
CONNIE A. MORELLA

by
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DIRECTOR
INDUSTRIAL PARTNERSHIP OFFICE
LOS ALAMOS NATIONAL LABORATORY
JUNE 27, 1995

Summary

Four key themes summarize this testimony:

• Continued and strengthened industrial interactions are absolutely essential to successful accomplishment of the missions of Los Alamos National Laboratory. The increased challenges to Los Alamos from the absence of nuclear testing, from future remanufacturing requirements, and from constrained budgets, require that we effectively utilize the best national sources of science and technology, including industry and academia. The three key reasons for the importance of industrial interactions are to (1) learn and incorporate "best practices" and industrial knowledge; (2) maintain and enhance core competencies; and (3) maintain the excellence of scientific and engineering staff.

• The proposed Technology Transfer Improvements Act of 1995 will positively impact the ability of the Laboratory to create and utilize successful industrial collaborations.

• The Cooperative Research and Development Agreement (CRADA) mechanism is a very important tool for industrial interactions. The laboratories use CRADAs, in collaborations with industry, to enhance mission-required technologies. Federal funds to support CRADAs are used by the laboratories for their own cost-share of the project. No federal funds are directed to industry under the CRADA mechanism. CRADAs provide the strongest example of a true dual benefit program built on leveraging of the taxpayers' investments. CRADAs are not a grant program to industry.

• The Department of Energy's Defense Programs Technology Transfer Initiative (TTI) is a critically important contributor to the Laboratory's ability to build and conduct successful industrial partnerships that enhance its core missions. TTI has significantly changed with time. Now, TTI partnerships are tightly integrated into the mission requirements of the nuclear weapons program.

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Introductory Comments

Thank you for the opportunity to testify before your committee today on the role of industrial partnerships at Los Alamos National Laboratory. In this testimony, I would like to discuss the importance of industrial interactions to our Laboratory's ability to accomplish its federal mission, and at the same time, note some examples of how those interactions impact the Laboratory's long-term ability to meet future national challenges involving science and technology. The benefits to our industrial partners will also be discussed somewhat more briefly.

I compliment Chairwoman Morella on the current draft of The Technology Transfer Improvements Act of 1995. This suggested amended language to the Stevenson-Wydler Act of 1980 will strengthen the Laboratory's ability to craft effective interactions with industry that provide incentives for both parties to engage in partnerships that enhance the nation's economic and defense bases. I will make specific comments on this bill later in my testimony.

First, I would like to briefly introduce myself to the Committee, because I believe that I bring a set of experiences to this testimony that are directly relevant to the issues under discussion today.

I've been at Los Alamos for half of the Laboratory's 52 year history. I was recruited by Los Alamos when I completed my graduate training . I came to the Laboratory because of its scientific excellence and its critical contributions to national security. I spent my first sixteen years at Los Alamos in a wide range of technical and leadership roles within the nuclear weapons programs, mainly in support of nuclear testing and development of laser fusion. I then managed significant parts of our Strategic Defense Initiative (SDI) efforts. In later positions, I managed the Laboratory's Department of Defense programs, including all SDI programs, and still later all environment and energy programs. I've thus been a contributor to most of the Laboratory mission areas.

I was selected in November 1993 for my current role as Director of the Industrial Partnership Office not because of my in-depth knowledge of U.S. industry, but for my in-depth knowledge of the mission responsibilities of the Laboratory. By including within

our office many people with strong industrial experience, our team effectively represents the mission needs of the Department as well as the requirements of U.S. industry.

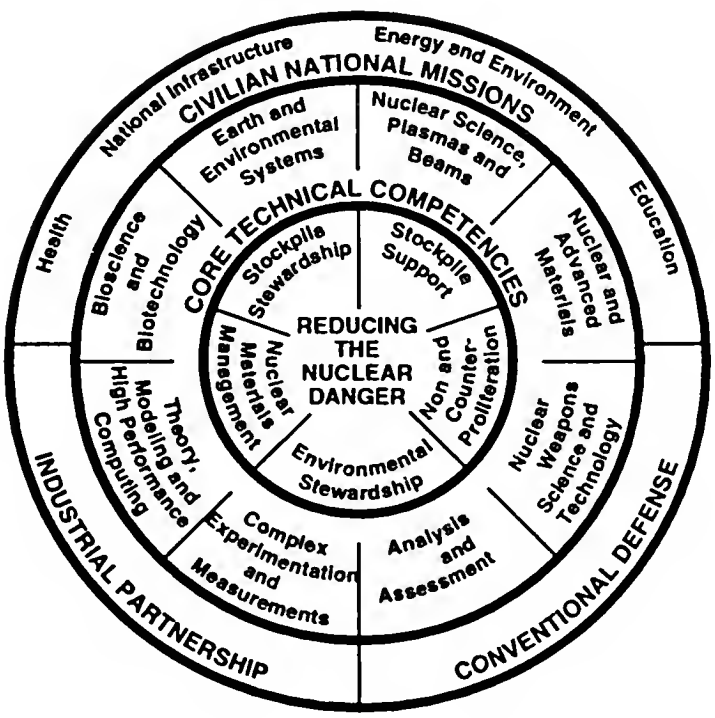
Even in my earliest years at Los Alamos, collaborative relationships with academia and industry were critical to our success. I used many of these interactions to optimize my group's contributions to the Laboratory's mission. We didn't have access to mechanisms like Cooperative Research and Development Agreements (CRADAs) in those days, and had to rely on procurement contracts that were not always well suited to collaborative arrangements with industry. Nevertheless, some of my interactions led to successful new products for U.S. industry, but these were also products that I critically needed to fulfill my mission responsibilities. Looking back on these early industrial interactions, the mechanisms available today would have tremendously improved my ability to effectively utilize U.S. industry in collaborative efforts.

As I will develop in this testimony, alliances with industry are critical to the future of Los Alamos. I'm in an exciting and challenging position as we seek to optimize the integration of industrial partnerships into Los Alamos programs.

The Mission of Los Alamos Today

The mission of Los Alamos today is focused on *reducing the global nuclear danger*. A central and vital component of that mission is nuclear weapons science-based stockpile stewardship--keeping those weapons safe, secure, and reliable. Stockpile stewardship also requires that the nation retains capability to respond to a variety of uncertain futures. *Reducing the nuclear danger* requires stockpile management--providing capabilities ranging from dismantlement to future remanufacturing. Much of the stockpile surveillance, dismantlement, and remanufacturing technological expertise will eventually reside only at the laboratories. *Reducing the nuclear danger* requires management of nuclear materials on not only a national, but also on a global, scale. *Reducing the nuclear danger* requires the development of effective nonproliferation and counter-proliferation technologies. We must keep nuclear weapons, nuclear materials and nuclear weapons knowledge out of the wrong hands. And finally, *reducing the nuclear danger* also requires that we clean up the legacy of 50 years of weapons production. We are turning our attention and technical talents to the environmental problems in the defense complexes of the United States and the Former Soviet Union.

The following diagram illustrates the concept of the core mission for the Los Alamos National Laboratory and the five elements of the core mission described earlier. This mission is supported by eight core competencies: nuclear and advanced materials; nuclear weapons science and technology; nuclear science, plasmas and beams; analysis and assessment; complex experimentation and measurements; theory, modeling, and high-performance computing; bioscience and biotechnology; and earth and environmental systems. These core competencies in turn provide the basis for us to participate in civilian national missions, conventional defense R&D, and, of special interest to this testimony, industrial partnerships. Our ability to support the central core mission is absolutely dependent on our maintaining and enhancing the core competencies, and those core competencies cannot be supported today solely by the nuclear weapons program. The mission areas on the outermost ring, together with the central core mission, provide the integrated basis for support of those core competencies. Our ability to accomplish our central mission depends on these core competencies!!



The challenges of the central mission of Los Alamos have substantially increased in complexity in the current environment. Now there is no nuclear testing; there are no new production cycles, and the once robust production complex no longer exists. Yet we must provide confidence that weapons in the enduring stockpile will perform reliably and with the highest standards of safety long after their initial manufacture and nuclear testing. As a result, Los Alamos must work toward still greater understanding of the science underlying stockpile integrity. We have to seek the best the country has to offer in advanced manufacturing technologies. To illustrate: Los Alamos must rely more on numerical modeling and computational simulations; utilize new and improved surveillance techniques to assess stockpile integrity; increase preventive maintenance procedures; and perform future limited remanufacturing with the most modern standards of agility, flexibility, and environmental consciousness. Furthermore, these requirements must be met at the same time that the federal deficit concerns place ever greater demands on the budgets allocated to the nation's nuclear stockpile activities. These challenges will only be met through better collaboration with industry for access to their technology and by introducing the best practices of modern successful manufacturing companies into the Laboratory. Additionally, we will require even better ties with universities to assure that their best basic scientific knowledge is built into our predictive and analytical capabilities.

At Los Alamos we fully support the view that partnerships with industry are derivative to our core mission -- a premise strongly endorsed by the Galvin Task Force report. We engage in partnerships with industry because we need access to their expertise to apply it to meet our mission goals; because the technological problems of industry provide a rich array of applications to which our scientists and engineers can address their skills and enhance the Laboratory's core competencies; and finally, because those problems help attract the best scientific and engineering talent to our Laboratory. I will further develop these attributes of partnerships in the next section.

The Importance of Industrial Interactions to Los Alamos

Technology partnerships with universities and industry are crucial to Los Alamos' nuclear defense mission. Indeed, our Director, Dr. Sig Hecker, has stated that he views these interactions as a business necessity for the Laboratory. I see three reasons for this that are further discussed below. I've provided some examples of ongoing partnerships that may further illustrate this rationale. Most of the examples are drawn from CRADAs funded

through the Defense Programs (DP) Technology Transfer Initiative (TTI), which is the primary source of funding for Los Alamos CRADAs.

• Learning and Incorporating "Best Practices" and Industrial Knowledge into Lab Missions
Los Alamos can learn "best business practices" through industrial interactions. Where science and technology reside outside of Los Alamos, interactions with appropriate partners enable us to obtain the right technology to solve our mission problems. Partnerships with technology sources are simply smart business from the taxpayers' perspective.

Science and technology reside within three pools of research and development in the United States: corporations, universities and colleges, and the federal laboratory system. Through partnerships, Los Alamos scientists and engineers team with the best researchers in industry and academia. They are exposed to the latest ideas and technologies being developed outside of the national laboratory system and have the opportunity to adopt the technologies and practices of the best, wherever they reside. As a result, the Laboratory becomes more efficient in its operations and delivers higher quality, more cost-effective, science and technology to its primary customers: the Department of Energy and American taxpayers. Formation of such strategic partnerships is not new to U.S. industry, indeed many of our country's most successful companies are actively exploiting such partnerships to optimize their own competitiveness.

As an example, Los Alamos must increasingly integrate manufacturing and maintenance with research and development to meet the nuclear weapons stockpile stewardship and stockpile management demands of the nation. The TEAM project, Technologies Enabling Agile Manufacturing, demonstrates how this "best practices" approach works. TEAM has Los Alamos, Sandia, and Livermore National Laboratories personnel from the areas of weapons and component manufacturing and engineering working with manufacturing engineers from companies such as Pratt & Whitney, Lockheed, General Motors, Ford, and Electronic Data Systems as well as small businesses, universities and trade groups. Los Alamos researchers, working with industry counterparts, bring state-of-the-art knowledge of manufacturing system engineering back to the Laboratory. Through TEAM, the laboratories can improve our ability to perform our stockpile stewardship mission.

As part of TEAM, Los Alamos leads the Virtual Manufacturing thrust that provides simulation and modeling of advanced manufacturing enterprises, processes, resources, and products in an integrated product and process design environment. Application of Virtual

Manufacturing tools throughout the design cycle ensures affordability, reduced time-to-market, and first-pass quality performance.

In another part of TEAM, Enterprise Modeling, Los Alamos is leveraging models developed for Defense Programs to simulate the functions, services, and processes of distributed manufacturing enterprises in collaboration with Pratt & Whitney. Los Alamos is also collaborating with two minority-owned small businesses, Intelligent Systems Technology and Standard Technology Inc., to develop additional enterprise models. These models are proving to be of great benefit for analyzing alternative resource configurations and conducting "what-if" manufacturing simulations to optimize and focus the enterprise.

Co-development of technology often provides both industry and Los Alamos with new tools that are used in very different, but equally critical, applications appropriate to their separate interests. For example, Los Alamos developed a new acoustic technique called resonant ultrasound spectroscopy to evaluate material properties of high-temperature superconductors. (In resonant ultrasound spectroscopy, the response of a material or component to sound waves is examined, which can provide great detail on the composition and integrity of the sample.) That technology has now been further developed through licenses and CRADAs with a small business into commercial gear usable for a wide range of characterization. That company is now selling non-destructive testing instruments for applications ranging from improved ball bearing characterization (critical in predicting and improving lifetimes of rotating systems) to improved ceramic oxygen sensors for a major U.S. car company. These same acoustic technologies are now also being used for characterization of weapon pits, part of the physics package within a nuclear weapon, at one of the Department's facilities. We anticipate that such improved acoustic technologies will be a key contributor to requalification of weapon components to minimize the need for additional production of plutonium components, which are the most cost-intensive components of weapon remanufacture.

Another good example of mission support involves an alliance created through DP funds, but not utilizing the TTI program. The project involves development of better perforators for applications in the oil industry. (Perforators are used to puncture an oil well casing in a carefully controlled fashion after an oil-bearing strata has been identified outside the casing.) One of the benefits of this project involves development of an economically viable commercial supplier of parts for detonators, the components that ignite high explosives. A particular type of detonator is used in nuclear weapons, based on its high

degree of safety and reliability. But the number of detonators needed by the nuclear weapons program is not sufficient to justify development of a commercial source for the starting stock for their fabrication, which is a copper-Kapton film. As a direct result of this project, a commercial small business supplier now exists to provide the film from which detonators can be made for Department of Energy missions and to supply the more substantial Department of Defense and commercial demand as well.

• Maintaining and Enhancing Core Competencies

By selecting the area of technology for emphasis and then structuring an appropriate industrial partnership carefully, we can both maintain and enhance the core technical competencies required for our defense mission. We find industrial interest in many of our key technologies - especially in areas like high-performance computing, modeling, and simulation; advanced materials and processing; advanced sensors; environmentally-conscious manufacturing; optoelectronics; and chemical processing. Industrial partnerships can provide challenges and opportunities to maintain and hone the quality of our science and technology and improve the overall capabilities of our technical staff. The ability of the Laboratory to contribute to future national priorities is directly dependent on the strength of our scientific and technical expertise.

As one example, the Los Alamos technology base in geophysics and computational modeling has been applied to improved characterization of underground oil and gas reservoirs through improved collection and interpretation of seismic signals and better characterization of the permeability of the underground rock formations. We have further improved this industry's capabilities through work with a major oil field service company to significantly improve the effectiveness of well-logging tools. In this latter effort, we applied a class of Monte Carlo radiation transport computer codes, developed at Los Alamos, to predict the interaction of radiation with materials (important in nuclear weapons design), to improve the accuracy of well logging. Through well-logging, the structure of geologic strata outside the oil well casing can be measured and potential oil-bearing formations localized. The improvements will ultimately provide crucial capabilities required by industry to develop new and improved logging tools and more accurate measurement interpretation, which translates into more economic recovery of oil and gas. Our defense mission also benefits directly from the improvements made in the computational physics capabilities and the development of improved user-friendly interfaces for the many Los Alamos applications of radiation transport codes, most of which have direct weapons applications.

Through the new Advanced Computational Technology Initiative (ACTI), we will further expand the development of partnerships with the oil and gas industry. For the industry, this can mean improved recovery by better relating seismic measurements and simulations to the parameters of each reservoir and well hole. ACTI projects also will contribute to explosives technology, the speed of simulation codes, and database development, all areas of mission relevance. Department missions also benefit from improved use of seismic signals to interpret underground disturbances, including clandestine nuclear detonations, and better tools for determining the safety of radioactive waste storage.

With Amoco Oil Company, we expanded an important defense mission research area, the study of turbulent interpenetrating material flows, and improved our ability to simulate these flows more accurately with massively parallel computers. The Department benefits from gaining a new, cutting-edge, computational vehicle with the ability to address crucial problems encountered in multi-phase flow reaction systems. Among Department programs that will benefit from this project are supercritical water oxidation of hazardous wastes and research into the chemical processes associated with accelerator-driven transmutation of nuclear wastes. Amoco, for its part, is now able to design more efficient processing systems for residual oil and heavy crude.

With General Motors we have had the opportunity to develop a novel idea for surface treatment of materials based on an invention at the University of Wisconsin. The University is also a partner in the collaboration. The Plasma Source Ion Implantation CRADA promises, in a cost-effective way, to improve hardness and wear of industrial materials in an environmentally benign process. In this project, surfaces of materials such as gears or dies are treated in a plasma generated with unique and costly equipment that the Laboratory was able to bring together from its fusion research, weapons program, and strategic defense research. With this CRADA we maintain and enhance plasma physics and pulsed power competencies at Los Alamos, critical areas underlying many of our defense missions. At the same time, it opens up the possibility of improving materials for enhanced nuclear weapons safety and for decontaminating surfaces of nuclear process equipment at sites such as Rocky Flats. The latter application is now under license for evaluation by a small business.

In another example through a partnership with DuPont, Los Alamos scientists built a neural network controller for a continuously stirred chemical reactor, which DuPont uses to create

certain polymer ingredients. To design the controller, the team developed and enhanced a neural network system designed at Los Alamos in the late 1980's. The new controller senses changes within the reactor and then adjusts the process parameters to keep it stable. This is done through "model-prediction," which means that the controller's sensors observe the behavior of the chemical plant and then extrapolate future behavior. The extrapolated behavior is compared with the desired future behavior and control actions are modified to match the two. The new technologies of neural networks and adaptive computation provide a basis for the development of such a control scheme. Since the chemical process in question is not completely stable, only this kind of real-time device could respond to the changing conditions quickly enough. The DOE weapons complex has similar problems in the development of new chemical processes that provide improved accountability of nuclear material and reduced environmental impact. The team has begun the installation of the controller in a deuterium-tritium separation laboratory at Los Alamos. DuPont plans installation in a chemical pilot plant in Oklahoma. Additional mission applications for this new controller technology are in widely divergent areas like control of satellites or for optimization of laser welding used in weapons remanufacturing.

Some Los Alamos CRADAs are funded by offices of the Department other than DP to develop and support a technology or research program directly addressing mission issues within those offices. For example, with a small Colorado company, Cryenco, we are developing a Thermoacoustic-Driven Orifice Pulse Tube Refrigerator - a refrigerator with no moving parts. This device will be used for the liquefaction of natural gas and can produce gas in both the liquefied and compressed forms. This program is funded by the Assistant Secretary for Fossil Energy as part of that Office's efforts to develop better technologies for the U.S. energy supply. This project draws on and enhances several core competencies at Los Alamos, and these competencies have relevance to our central mission as well.

It is no coincidence that there exists a close match between CRADA projects and the technologies required by the Los Alamos core mission, since dual benefits are a key selection criteria for any CRADA. We have evaluated these matches for CRADAs funded through the TTI program. Twenty-seven percent of our TTI CRADA projects support computational and information sciences. Sensors, diagnostics, and instrumentation account for 12% of our TTI CRADAs, while advanced manufacturing plus electronics and microelectronics account for 28%. Materials and processing technologies account for 16% of our TTI CRADAs. In fact, the CRADAs underway at Los Alamos already fit the

guidance provided by the Galvin Task Force that partnerships should focus on areas of technology relevant to Laboratory mission areas.

• Maintaining the Excellence of our Scientific and Engineering Staff

Carefully selected industrial interactions help the Laboratory to provide a stimulating research environment that allows us to attract and retain world-class research talent for Los Alamos to serve the nation. It is only by maintaining our excellent human and facility resources that the Laboratory can meet the future technical challenges of the nation.

The great strength of our Laboratory is the quality of the science and technology it is able to apply to its mission. Indeed, the Laboratory's very identity and international recognition rest upon the sustained excellence of our staff in satisfying national needs in science and technology. The high priority placed by the nation on science and technology because of the challenges of the Cold War allowed us to attract and keep a high quality staff. Today, with the end of the Cold War, we must ensure that sufficient challenge and opportunity exist at Los Alamos to recruit and retain the world-class staff that supports the quality of our science. Many of our industrial interactions provide just that level of challenge. We can point to specific examples at Los Alamos where technical groups were able to recruit and hire highly qualified staff members, only because their assignments were a balance between industrial interactions and weapon program projects. They would not have joined Los Alamos only to work on the weapons programs. One of these scientists is working on a project with General Motors to improve metal casting, while contributing to this same research area, albeit with very different metals, as part of an ongoing weapons remanufacturing challenge.

An excellent example of how collaborations with industry stimulate the national laboratories is the CRADA between the Semiconductor Research Corporation (SRC) and the Los Alamos, Lawrence Livermore, and Sandia National Laboratories. This activity also includes the university community, which is supported by the SRC to do basic research and will ultimately provide graduates for employment in the semiconductor industry. One or more universities will be involved in each technical project under the CRADA and will work closely with the national laboratories to develop improved physical models and simulators which the industry needs in order to design and manufacture future generations of devices. These improved models and simulators will then be tested and validated by the SRC member companies and ultimately distributed to U.S. semiconductor companies for their use.

In the implementation of this activity, faculty members and students from the participating universities will spend extended periods of time at the laboratories, as will individuals from the member companies. Likewise, national laboratory scientific and technical personnel will spend time at the member companies while the models and simulators are being tested. This entire process--the collaborative process to produce innovative new approaches to semiconductor modeling and the intellectual stimulation through the exchange of personnel during various phases of the collaboration--provides a new model for developing highly qualified university graduates potentially available for employment by the national laboratory system as well as for a critical industrial sector. The model also creates a process in which private and federal interactions not only stimulate the scientific and technical staff at the national laboratories, but also their counterparts in industry and academia.

The Importance of Partnerships to Industry

While the Laboratory must view partnerships from the perspective of impact on core missions, industry must evaluate their role in a partnership from their competitiveness perspective. Partnerships enable industry to meet its business objectives by staying ahead in a technology-challenged competitive global marketplace. In surveys completed by our CRADA partners, 69% identified the development of new or improved products as the most important benefit they expected from their project. Other major benefits identified were the development of new or improved processes and acquisition of knowledge.

Improved operations and competitive position by U.S. industry not only make fiscal sense to the partnering company, but also make sense in supporting global economic growth for U.S. industry as a whole. Partnerships allow industry to leverage the taxpayers' investment in the Laboratory's competencies, while at the same time the Laboratory is leveraging the industry's investment in science and technology.

In each of the examples noted earlier, I discussed the benefits of that alliance with U.S. industry.

The Impact of Partnerships with Small Businesses

Small businesses play an especially vital role in the nation's innovation and industrial efforts. For this reason they receive special emphasis in several federal programs and are also singled out for special treatment with a portion of the DP TTI funds. While the fraction of TTI funding designated for small businesses, around 5%, is not large, the impact of that funding on small businesses has been especially important. Many small businesses have noted that their successes were vitally impacted by assistance derived from TTI funds. About 40% of our CRADAs are with small businesses. Even in our small business CRADAs, we seek contributions to mission relevance, although we can not place these low-cost, short-time, interactions through the same very narrow filter for mission relevance that we demand of partnerships that span years of effort with large dollar commitments from all parties.

Small business represents a significant fraction of activity in another area of industrial interactions at Los Alamos. We find that licensing of intellectual property is of particular interest to small business; more than 60% of our licenses are with small businesses.

As one example, LIDAR (LIght Detection And Ranging) is one of many technologies that Los Alamos developed and enhanced with small business industrial interactions. LIDAR enables remote evaluation of atmospheric composition, and can, for example, be used to detect chemical agents or pollutants in the atmosphere. Transport of pollutant plumes has been demonstrated in Laboratory projects, all with U.S. industrial participants, ranging from Mexico City to Barcelona to Albuquerque. Through licensing, a small business is now marketing some of the analysis and display capabilities required for the volumes of data returned by this system. This company is focusing on applications of LIDAR to public transportation and the related pollution concerns with projects now in many states.

Status of Industrial Interactions at Los Alamos

I noted earlier that procurement mechanisms were used for some early industrial interactions at Los Alamos before the more modern mechanisms became available. In the late 1980's, Los Alamos experimented with other approaches, like the Superconductivity Pilot Center and the Oil Recovery Technology Partnership. Both have been highly successful, were well utilized by industry, and continue to this day. In fact, the current Superconductivity Technology Center recently announced a dramatic breakthrough in

development of flexible composites for industrial applications of high temperature superconductors that may enable dramatic expansion of the utilization of these potentially revolutionary materials, which will impact both the commercial and military sectors. Both of these programs involved industrial alliances in the days before CRADAs were authorized, and they served in part to define the evolution of the CRADA mechanism.

Bipartisan consensus in the late 1980's and early 1990's created key legislation that enabled the CRADA as an industrial interaction mechanism available to national laboratories. For Los Alamos, the CRADA has become the most important contractual vehicle in our suite of interaction mechanisms. Los Alamos currently has 169 CRADAs with total (federal and private) value in excess of $387 million over the lifetime of the projects, usually three to four years. TTI CRADAs account for $43M in this fiscal year's Laboratory budget. The Laboratory's challenge is not in finding opportunities with industry, but in deciding which of those opportunities possess the greatest potential for return to the Laboratory--return in the sense of maintaining and advancing the Laboratory's core competencies in support of its primary missions. Most of the funding to date for CRADAs at Los Alamos has come from the TTI program. Of our 169 CRADAs, 139 are TTI CRADAs.

CRADAs have proven to be an effective vehicle for industrial interactions, although we continue to need a range of vehicles to address specific opportunities. We make use of user facility agreements, proprietary information agreements, licensing agreements, and other approaches to tailor an optimum response to each circumstance. We still do some industrial collaborations through procurement vehicles, like I did years ago, but now we have the ability to choose the best vehicle for each challenge.

Los Alamos has over 63 facilities identified for potential industrial use, and 29 of these facilities have now been officially approved by the Department of Energy as user facilities. Some of these facilities have had many different users; our Computational Testbed for Industry, as an example, has been used by more than 42 companies, including both large and small businesses. We have over 50 commercial licenses. We executed 306 proprietary information agreements with industry just in fiscal year 1994 alone. Technical assistance to small business (through agreements that allow up to $5000 of internal funding to our technical staff) have been of great interest to small companies. We've funded about 190 of these agreements with companies in 30 states.

The contribution by industry to partnerships with Los Alamos is significant. More than half of the value of partnerships, about 58%, is contributed by the private sector contribution through either in-kind or cash contributions. Industrial funds received in this fiscal year are: $1.4M in industrially funded CRADAs, $6.6M in industrial funds-in agreements, and $1.6M in user facility agreements.

None of the industrial interaction mechanisms transfers federal funds directly to companies; transfers from the Laboratory always consist of technical expertise or facility utilization.

The CRADA Mechanism for Industrial Alliances

It is critically important that the Committee fully appreciate the differences between the Laboratory's use of the CRADA vehicle for industrial collaborative partnerships and federal grant programs to industry like the Department of Commerce Advanced Technology Program (ATP) or the Department of Defense Technology Reinvestment Project (TRP). In the CRADA mechanism, no government funds are provided to industry; instead a program is defined through which both parties can collaborate while advancing their own individual goals. In well-crafted CRADAs, Laboratory missions benefit from the industrial input, while at the same time industrial needs are met through the Laboratory's contributions. The decision by Los Alamos to work with an industrial partner company, or consortium of companies, is driven by the mission requirements of the Laboratory. Certainly each collaboration must offer significant benefits to industry, otherwise industry has no incentive to join the partnership and commit scarce technical resources and expertise. On the other hand, we believe that the primary driver for partnerships must derive from the Laboratory's federal missions. In the TRP and ATP programs, after selection is made of a company's proposal, government funds flow directly to the company to partially support the technology development.

CRADAs represent a true opportunity for significant dual benefit - Laboratory missions benefit from industrial contributions and U. S. industry benefits from utilization of the world-class infrastructure, technologies and capabilities developed at the Laboratory in support of federal missions. Both the Laboratory and industry are able to leverage their investments.

Department of Energy CRADAs developed a negative image in their early years based on the administrative burden that often resulted in protracted interactions between the Labora-

tory and its industrial partners. More recently, dramatic improvements in flexibility and processing time have significantly reduced most of the concerns. CRADAs are now processed at Los Alamos in an average of about 40 days, measured from the time when a Joint Work Statement is finalized to the date the CRADA is signed. While there are still examples of time consuming negotiations where a partner has specific concerns with even the more flexible provisions of the Department's modular CRADA, I strongly believe that the CRADA is an effective tool for collaborative industrial interactions. I expect further optimization of the CRADA process with additional experience and effort.

The Technology Transfer Improvements Act of 1995

I view the April 17 draft of the Technology Transfer Improvements Act of 1995 as a positive addition to the legislation underpinning industrial interactions with the national labs. This Act would provide further confidence to a company that it can effectively utilize and control intellectual property developed through such collaborative projects. I concur that restricting this intellectual property control to the field of use of the CRADA is critically important. Without that field of use restriction, I believe that the Laboratory would view CRADAs as a disincentive for industrial collaborations in areas of technology closest to our strongest capabilities, out of fear that an entire broad area of technology would be controlled solely by a single company or consortium. But with the field of use restriction, as the Act now specifies, the net effect will be positive for the industrial collaborator without raising concerns within the laboratories.

The Act also requires monetary recognition of the laboratory staff responsible for developing the intellectual property licensed by industry whenever royalties or fees are paid. Through this requirement, each laboratory will benefit from the creation of a larger pool of staff members who can serve as strong internal advocates for the benefits of industrial collaboration. While monetary compensation of laboratory individuals is certainly not the prime reason for laboratory-industry collaboration, we need to recognize that the individual staff members must invest significant non-research time and effort protecting intellectual property and in developing an effective industrial collaboration. Prompt monetary recognition will assist by adding impetus to the collaborative process. We are currently in the process of changing the royalty distribution policy at Los Alamos, while staying within the guidelines of our University of California (UC) contract, to provide a monetary return to every staff member who develops intellectual property that is

licensed to, and returns royalty or fees from, industry. This is consistent with the Act's language.

Other aspects of the Act, such as enumerating the uses of royalty and other industrial income, are also positive additions to the overall process of recognizing and encouraging industrial collaborations that both benefit laboratory mission areas and enhance U.S. industry's competitive position.

I have only a few suggestions to improve the proposed Act:

- The present language states that the industrial partner shall "choose" the field of use. I'd suggest that the interests of the taxpayers might be better served if, instead of providing the partner with the right to choose any definition of a field of use, the laboratory and industrial partners would negotiate a mutually agreed upon field of use.
- Some parts of the present draft could be clarified as to their applicability to Government-Owned, Government-Operated (GOGO) laboratories or to Government-Owned, Contractor-Operated (GOCO) laboratories. For example, the UC royalty policy is more generous than that proposed in the Act, and I doubt that Act intends to provide a disincentive to UC GOCO laboratory scientists by imposing a reduced royalty policy.
- Finally, the phrase, "Technology Transfer," in the title of the Act paints an unfortunate picture to many, that of industry simply removing fully developed technologies from a well-stocked shelf at a federal laboratory for immediate commercialization. That simply is not the reality, although many industries initially approach the laboratories with that expectation. Technologies are developed within a laboratory to meet national mission requirements, and it is very rare when those laboratory mission requirements drive a technology close to market needs. Industrial interactions virtually always involve some degree of collaboration and/or some significant degree of industrial development before they are ready for the marketplace. For this reason, my Office at Los Alamos is titled the Industrial Partnership Office, not the Technology Transfer Office. Phrases like "Industrial Alliance," "Industrial Partnership," "Industrial Collaboration," or "Industrial Interaction" are closer to reality than "Technology Transfer."

The Technology Transfer Initiative

The Technology Transfer Initiative (TTI), a set-aside program for technology partnerships with industry, started as a program within DOE Defense Programs to increase the industrial interactions of the national security laboratories. TTI projects focus on supporting and

enhancing federally-funded laboratory-based technologies required for a laboratory's primary mission, while at the same time enabling U.S. industry to maintain and enhance their capability to apply that technology for their own competitive needs. In the truest sense, TTI projects provide dual benefits with significant leveraged benefits to the U.S. taxpayer.

TTI has been successful from the perspective of dramatically increasing the extent of our industrial interactions and thereby the recognition within the Laboratory of the benefits to be realized through industrial partnering. From its inception, TTI emphasized cooperative, cost-shared projects and utilized the CRADA mechanism to provide significant protection for industries' intellectual property. However, in its earliest days, TTI focused on industry-driven projects. Dual benefits were required for each project, but the tendency was to primarily examine the benefits to industry.

Today's TTI program is dramatically different in this last respect. This difference is driven by the increased challenges to the Laboratory today - derived from the absence of nuclear testing, a future Laboratory role in weapons remanufacturing, and very tightly constrained Laboratory budgets. Mission relevance must now be paramount. Thus, new TTI partnerships emphasize these mission and program needs of the Laboratory and we seek industrial partners who can best complement these mission requirements. We are now in a transitional phase between continuing partnerships and new partnerships crafted with tighter mission relevance. We have also evaluated all ongoing partnerships against the more rigid requirements we impose today. About 80% of those older partnerships still provide a high degree of benefit to mission areas. Many ongoing partnerships are also being adjusted to enhance their mission relevance.

Creation of a mutually beneficial partnership always requires extra initial effort to craft a successful collaboration that returns dividends in the future. The "set-aside" nature of TTI funds specifically for industrial collaborations has provided a critical extra incentive to our staff to develop effective partnerships. It is all too easy for our staff to retreat into their individual labs and avoid the complications of a partnership if the staff's focus is only on the shorter-term deliverables of their current assignment. TTI provides motivation to invest the up-front effort to develop the partnership to realize the longer-term benefits that successful collaborations provide.

Over the next few years we see the laboratories integrating their research and development in nuclear weapons stockpile stewardship with nuclear weapons remanufacturing. To offer the nation the ability to remanufacture whatever will be required in the future stockpile without maintaining a large and expensive production complex in a standby mode, we will have to develop agile manufacturing techniques similar to those American industry is developing to stay competitive in a global market place. In the future, small numbers of a variety of remanufactured weapons and/or components will likely be needed, and this will require a highly flexible manufacturing capability with the highest quality assurance standards. Hence, an important focus for future cooperation with industry must be based on providing benefits for the nation's nuclear weapons remanufacturing program. In some cases, we can work cooperatively with U.S. industries to develop manufacturing capabilities that will not only enable future weapon component remanufacturing, but also advance the state-of-the-art in the manufacturing sciences crucial to U.S. industry - and these are the cases that represent ideal partnership opportunities. We have found the CRADA mechanism and the TTI funding channel to be a very useful way to encourage this mutually beneficial arrangement.

I have very serious concerns with suggestions from some in Congress to terminate or sharply reduce the TTI effort in fiscal year 1996. Not only would we lose the mission benefits outlined above, but if we are forced to terminate ongoing industrial partnerships through lack of resources, we brand the government and the Laboratory as unreliable partners for U.S. industry. Given the vital nature of industrial partnerships in the future ability of the Laboratory to meet mission expectations, any loss of credibility in the sustainability of negotiated and ongoing industrial partnerships with Los Alamos would have drastic ramifications as we seek to craft new partnerships supporting our defense missions. I encourage the Congress to continue its support of the TTI effort.

Conclusion

Congress should continue to encourage a range of relationships among national laboratories, universities and industry. Both federal missions and our country's competitiveness will be strengthened as a result. Both the CRADA mechanism and the DP TTI program are major components of the Laboratory's ability to leverage taxpayer-supported mission research through involvement of U.S. industry.

Four key themes permeated this testimony:

• Continued and strengthened industrial interactions are absolutely essential to successful accomplishment of the missions of Los Alamos National Laboratory. The increased challenges to Los Alamos from the absence of nuclear testing, from future remanufacturing requirements, and from constrained budgets, require that we effectively utilize the best national sources of science and technology, including industrial and academic opportunities. The three key reasons for the importance of industrial interactions are to (1) learn and incorporate "best practices" and industrial knowledge; (2) maintain and enhance core competencies; and (3) maintain the excellence of scientific and engineering staff.

• The proposed Technology Transfer Improvements Act of 1995 will positively impact the ability of the Laboratory to create and utilize successful industrial collaborations.

• The Cooperative Research and Development Agreement (CRADA) mechanism is a very important tool for industrial interactions. The laboratories use CRADAs, in collaborations with industry, to enhance mission-required technologies. Federal funds to support CRADAs are used by the laboratories for their own cost-share of the project. No federal funds are directed to industry under the CRADA mechanism. CRADAs provide the strongest example of a true dual benefit program built on leveraging of the taxpayers' investments. CRADAs are <u>not</u> a grant program to industry.

• The Department of Energy's Defense Programs Technology Transfer Initiative (TTI) is a critically important contributor to the Laboratory's ability to build and conduct successful industrial partnerships that enhance its core missions. TTI has significantly changed with time. Now, TTI partnerships are tightly integrated into the mission requirements of the nuclear weapons program.

From the perspective of U.S. industry, nowhere else, neither in universities nor in industry research laboratories, can be found the breadth of multidisciplinary scientific and technological expertise that exists in the national laboratories. By encouraging dual benefit alliances involving the national laboratories with US industry, the laboratories' competencies will be enhanced and maintained, with direct contributions to the laboratories' federal missions and to the competitiveness of U.S. industry.

Biography of
Dr. Peter B. Lyons

Pete Lyons is currently the Director for Industrial Partnerships at the Los Alamos National Laboratory, appointed to that position in November 1993. In this position, he is responsible for all industrial interactions and industrial partnership activities conducted by the Laboratory. The Industrial Partnership Office is responsible for all industrial agreements and for Laboratory interactions with the Department of Commerce.

In 26 years at the Laboratory, Lyons has held a number of positions. In his previous assignment, he was Deputy Associate Director for Energy and Environment which included oversight of four technical divisions and all energy, environment, and industrial interaction programs.

Since joining the Laboratory in 1969, Lyons has held a number of research and management positions including Group Leader for Fast Transient Plasma Diagnostics, Program Director for Nuclear Defense Research, and Deputy Associate Director for Defense Research and Applications. In this latter position, he was responsible for all programs with the Department of Defense, including all Strategic Defense Initiative programs.

His research interests have focused on diagnostics of nuclear tests, inertial confinement fusion, and other high density plasmas. He has published widely on x-ray calibration systems and detection systems, development of high speed measurement and data transmission systems, and development of fiber optic systems and technologies. He has published well over 100 papers, holds three patents, and has chaired many national and international conferences. He also served as chairman of the NATO Nuclear Efforts Task Group for five years.

Prior to coming to Los Alamos he studied for five years at the California Institute of Technology. He received his Bachelors in Physics/Math from the University of Arizona in 1964, and his Ph.D. in Nuclear Physics from the California Institute of Technology in 1969.

Lyons has been very active in community activities, including elected service for sixteen years on the Los Alamos School Board and six years on the University of New Mexico-Los Alamos Branch Advisory Board.

Mr. SCHIFF. Thank you, Dr. Lyons.
Mr. Martin.

STATEMENT OF WILLIAM MARTIN, VICE PRESIDENT, OFFICE OF TECHNOLOGY TRANSFER, LOCKHEED-MARTIN ENERGY SYSTEMS, OAK RIDGE NATIONAL LABORATORY

Mr. MARTIN. Chairman Schiff, Chairwoman Morella, distinguished members of both Subcommittees, it's a pleasure to be here today.

The first comment on the Morella Bill, we really feel that this version of the Morella Bill is a very positive bill. We'd like to congratulate the staff and the committee for the bill in its present form. We think it is a win-win for both the government and the private sector.

You have our written testimony. Let me sort of summarize somewhat philosophically about technology and technology transfer.

It seems to me that the Federal agencies, wherever they might be, need to form their science and technology programs within the missions agreed to by Congress. That's a given.

Once these agencies then conduct and perform those technology programs with both the private sector, the universities, and the Federal laboratories, and normally those efforts are in the category of high benefit/high risk that the private cannot or is not willing to do, then the question becomes, what do you do after you generate the technology? Do you let it sit there, or do you transfer?

It seems to me that it is also a given that once you generate the technology, of course you transfer. The question becomes, how and what methods do we transfer these technologies? And as my associates and peers have gone through, there are many methods which the laboratories and universities use.

This business of technology transfer is not the passive one that some people refer to it, in which you flip charts over the wall, or reports over the wall, or data through the Internet. It's a mix of people getting together and being involved in doing things. That's the only way you effectively transfer technology to the private sector that's for the benefit of this country.

And that range of things, people like personnel exchanges, user facility agreements that people have mentioned already, the licensing of intellectual properties, cost shared subcontracts, work-for-others agreements, technical assistance, and of course, CRADAS, fits into that methodology.

And a major concern for all of you and all of us, and the nation, is, how can we do technology transfer better? We believe, to enhance this level of interaction between the private sector and the Federal laboratories that the technologies are supporting, they're not fully visible to the private sector to use.

And so, one of the things at the top of the list is the awareness to industry of the technologies available. And we encourage groups, using every means possible, to try to make the technologies that the government supports more visible to the private sector.

(B) We need to strive to have the industry involved earlier in R&D projects. And there's two reasons for this. One is that by co-developing the technology within the mission of our federal agency, that process itself helps transfer the technology to the private sec-

tor. It allows it to be better focused, market-driven, if you like to use those terms.

But it meets the requirement of the agency, and it meets the requirement of the private sector, who has to do something with it.

We talk about creating jobs. We talk about investments in the private sector. My friends, those are things that Federal laboratories don't do. Those are the collateral benefits that recur as a result of transfer of the technology.

(C) We certainly ought to engage in the process of total quality management and continuous improvement. There's never been a program that can't be improved. And at some of our sites, we've had programs going on there for several years, and we're quite proud of those, and we'll continue to do those, to make what is pretty good now much better.

Finally, I would say, in this process of improving technology transfer, we need to reduce some of the legislative and administrative barriers that inhibit the process of industrial collaboration.

So in summary, I would say there are a number of things—I mentioned those in the written testimony—as what we think ought to be corrected, and ways to go, and some of our successes.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Trivelpiece follows:]

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6/21/95

Testimony of
Alvin W. Trivelpiece
Director, Oak Ridge National Laboratory and
Vice President, Lockheed Martin Energy Systems, Inc.
Oak Ridge, Tennessee

before

The United States House of Representatives
Committee on Science
Subcommittee on Basic Research
and
Subcommittee on Science

June 27, 1995

I want to express my appreciation to the members attending this joint committee hearing for the opportunity to address you on the important topic of federal Technology Transfer. These DOE facilities at Oak Ridge include the world class research capabilities of the Oak Ridge National Laboratory, the Centers for Manufacturing Technology, and the Centers for Environmental and Waste Technology. These facilities house a unique collection of physical resources that have produced significant technology for energy research, national security and other DOE programmatic missions. However, throughout their existence, it has been the dedicated employees within these facilities that have been the intellectual power behind the many successes realized on behalf of this nation.

The proposed legislation under consideration addresses amendments to the Stevenson-Wydler Technology Innovation Act of 1980. This Act has been a most important vehicle to engage the private sector and government-owned laboratories in the process of leveraging taxpayers resources for continued public benefit. Specifically, this proposed amendment deals directly with issues pertaining to inventions made under Cooperative Research And Development Agreements, or "CRADAs", and the enhancement of commercialization of technology. As you may be aware, we presented testimony before the Subcommittee on Technology, Environment and Aviation last fall. The focus of that testimony was HR3590, an earlier version of the current amendment proposal. While we were generally supportive of the earlier version, we did express a concern regarding the need to distinguish between a government-owned, government-operated (GOGO) laboratory versus a government-owned, contractor-operated (GOCO) facilities. I am pleased that this bill appropriately addresses that distinction

One major focus area of HR3590 and the amendment, now under consideration, is the subject of royalties and incentives to commercialize technology. We continue to view this resolution of this issue favorably. It has been demonstrated that sharing the royalty stream with inventors will provide an incentive to technology innovators within the GOCO organizations. We congratulate the committee on the provisions included in this amendment and believe that the

proposed royalty sharing will provide a positive incentive to GOGO operations as well. As in the proposed legislation, our policy in Oak Ridge has been to reinvest royalty payments in the technology commercialization effort and to create an incentive for our technology innovators and support staff. From a policy perspective, the first benefactors from our royalty funds are the inventors who receive 15 percent of the royalty receipts. We distribute an additional 10 percent to those technical support staff members who have made significant contributions to specific inventions within the research organization. We consider these technical support personnel to be a vital element in the technology commercialization process.

During the past decade, the perception has been that these incentives have increased our number of invention disclosures. Indeed, invention disclosures have risen from about 80 per year in 1985, prior to implementation, to a range of 150 to 200 per year from 1986 through 1994. However, other factors may have also contributed to the positive change. Not more than 50 percent of the royalty payments are dedicated to our efforts to provide awareness and outreach programs and pay income tax on royalty earnings. The outreach activities provide the private sector with increased awareness of our programs and increase the potential for engaging CRADA partners and potential licensees for DOE developed technology. We also distribute at least 25 percent of the royalties within the laboratory to support technology maturation projects.

We also expressed our opinions last fall on a proposed provision that conveyed title to the partner of all jointly developed intellectual property emerging from cooperative agreements. We believe that the revised approach which grants the participant the option to an exclusive license for a field of use laboratory or jointly developed inventions affords the collaborating partner the necessary freedom to commercialize the research results. At the same time, the participating laboratory can license other potential fields of use for the technology. This too has been approached in a manner that is fair and equitable to all collaborating parties. Indeed, as presented today this proposed legislation has addressed a number of issues that should enhance the CRADA process. The members of the committees represented here today are to be commended for being responsive to these issues and the concerns of the various parties. The result is a balanced piece of legislation.

However, these cooperative agreements represent only one of several valuable vehicles used in the technology transfer process. Therefore, with your permission, I would also like to discuss the process of technology transfer and the commercialization of Federally funded technologies from a broader perspective. To frame this discussion it will be important to understand the basis of my remarks.

First, we in Oak Ridge, Tennessee have been engaged for some time in the federal technology transfer effort and have a unique vantage point of a co-located multi-program research facility (Oak Ridge National Laboratory) and a weapons production plant. No other federal facility enjoys the presence of a multi-program laboratory and the availability of full scale and operational federal production facility in such close proximity to one another. This vantage point has provided us with a valuable base of experience and source of learning in the technology transfer arena for over a decade. The transfer of know-how from the laboratory depends primarily on our researchers interaction with the private sector. We view the process of technology transfer from a broad perspective, and not just the volume of CRADAs we execute or the number of partners with which we interact. Rather, the full cycle of technology transfer spans across an array of mechanisms and tools including:

- USER Facility Agreements,
- Licensing of Intellectual Property,
- Cost shared Subcontracts,

- Work for Others Agreements,
- Personnel Exchanges,
- Technical Assistance, and
- of course, CRADAs.

It is from this perspective, which has been forged over 10 plus years, that I would like to focus the remainder of my comments.

A significant factor in the Oak Ridge success story is founded in the fact that we have a unique management and operating contract for the Department of Energy facilities in Oak Ridge. We manage and operate

- the Oak Ridge National Laboratory that performs research that spans from basic energy research and neutron science to advanced materials and biomedical sciences.

- the Centers for Manufacturing Technologies located at the Y-12 Plant, a Defense Programs facility that is focused upon transferring the high quality manufacturing expertise from weapons production to application in American industry.

- The Centers for Environmental and Waste Technologies located at the K-25 site provides access to premier facilities for the application of government and privately developed technologies to address environmental issues in this country.

These diverse and unique facilities, combined with the people and decades of expanding expertise, have enabled us to have an aggressive technology transfer program that continues to produce outstanding results.

Secondly, we have developed a partnership with the DOE Oak Ridge Operations Office that has struck the right balance with the necessary legislative authority between an appropriate level of oversight and management of the technology transfer function. At the same time this has left us wide latitude and flexibility to mold technology transfer "deals" with both the private sector and academia. We license DOE developed technologies via a license specimen agreement approved by DOE that has boilerplate terms and conditions that satisfies both government and taxpayers interests. We are free to negotiate royalty and commercialization plans with the objective of achieving effective commercialization, but always tempered with our being accountable as stewards of the taxpayers' dollars. If we become overly prescriptive in the "how to" manage the technology transfer function or become involved in tracking minuscule performance measurements, I believe we will be concentrating on reporting results as opposed to creating them. Ultimately the taxpayers and the U.S. economy will suffer. Alternatively, empowerment with a strong commitment to overall performance is the key. We have been and can be in the future, successful by remaining flexible while retaining the accountability of performance for the taxpayer's investment.

As a part of our technology transfer effort we strive to implement continuous improvements and we measure the operating results. These results offer a point of departure for us to make real time adjustments to the way we conduct business and allow us to do so in an informed manner. I would like to take a moment to share some of our metrics and a few success stories from Oak Ridge. We believe that reviewing examples such as these serves to support the congressional findings that are an integral part of the proposed bill under consideration. We are also of the opinion that the federal investment in research facilities and resources can and should be a significant competitive factor in the future of U. S. industry.

Through the years we have been fortunate to enjoy a number of solid successes in the transfer of DOE technology. Recently, our research staff in the Metals and Ceramics Division of Oak Ridge National Laboratory have worked with a small emerging company to accomplish an achievement that skeptics said could not be done. Lambda Technologies, Inc. has based its entire business upon a military technology it licensed from the Oak Ridge Office of Technology Transfer. This "variable frequency microwave furnace" will have application in sintering high-tech ceramics, medical equipment sterilization and facilitate development of other advanced materials processes and applications.

Major corporations have also found value added resources and technology at the DOE facilities in Oak Ridge. 3M has recently licensed a hot gas filtration technology for the electric power industry. A thin film battery technology developed by ORNL, that is expected to be an efficient low cost power source, has been licensed to Teledyne.

The Oak Ridge Centers for Manufacturing Technology (ORCMT) at the Oak Ridge Y-12 Plant has joined with Cincinnati Milacron, The Eaton Corporation, Focus: Hope, and the Science International Corporation (SAIC) in a project to improve the throughput of computer-controlled machining centers. Cincinnati Milacron, world leader in manufacturing precision machine tools, has loaned ORCMT a Magnum 800 machining center for the duration of the project. This sophisticated machine tool is located in the Machining Technology Access Center at the Y-12 Plant. It was the center of attention at the Oak Ridge Summit with Dr. Richard Kegg, Cincinnati Milacron Vice President of Technology and Manufacturing Development, officially initiated the project with a ribbon cutting ceremony. Eaton, an automotive parts manufacturer, will supply test workpieces, such as heavy-duty truck transmission cases, and also perform prototype testing operations at the Eaton Manufacturing Technologies Center in Cleveland, Ohio. The Focus: Hope Center for Advanced Technologies in Detroit, Michigan, which offers a six-year educational program combining hands-on manufacturing with academic training in a production environment, also will act as a test site while producing products for Detroit auto makers. It is important to Defense Programs because the equipment on loan is being evaluated for mission work applications.

Another equally exciting example is the successful commercialization of the PNEU-worm™ robot which is used to inspect the internals of piping that are difficult, if not impossible, to reach. Remotec Inc. expects this licensed technology to "be the most productive for our business." The prospects of inspecting complex shaped pipes in heat exchangers and condensers for the chemical, petrochemical industries is exciting. Both the energy generation and the environment will benefit. The spin-offs to inspect sewers, utility infrastructure in cities and counties are fantastic. Remotec was able to license this technology and bring it to commercial application in less than two years.

Technical experts from the Oak Ridge National Laboratory and the Thompson Cancer Survival Center, in nearby Knoxville, Tennessee have collaborated to develop a non-surgical, laser based method of cancer diagnosis and treatment. The research team has dubbed this new technique an "optical biopsy" because only light is used to determine the presence of malignant cells. As a result, the patient does not have to recover from pincers tearing tissue or wait for lab results. The diagnosis is made almost instantly. This same exciting technology is also being applied to conduct non-invasive diabetes tests and has been licensed by Oak Ridge National Laboratory to SpectRx, a company from Norcross, Georgia.

But, of course, not all collaborations are successful. Because we venture into high-risk, high-benefit projects that the private sector can't afford to unilaterally fund or provide technical assistance that is not otherwise available, we will have some interactions that do not meet expectations.

Based upon our decade of experience, and the results from our independent studies, we believe that there are other things that can be done to enhance the level of success from interaction between the federal laboratories and American industry. We can make significant improvements in the Technology Transfer effort by: (a) improving the awareness of industry with regard to federal laboratory mission programs and capabilities, (b) striving to increase industry input for market-driven projects when appropriate to the funding agency's mission, (c) engaging in the process of total quality management and continuous improvement, and (d) reducing the legislative and administrative barriers that inhibit the process of industrial collaboration.

Efforts have been made by the DOE to provide user friendly tools to assist with agency level administration of the technology transfer process. Two examples are the recently implemented Small Business Cooperative Research and Development Agreement and the Modular Cooperative Research and Development Agreement which was developed by the DOE and its contractors. These new tools provide pre-approved terms and conditions and have significantly reduced the negotiation process and the time required for approval. Our experience with these tools supports the DOE premise that providing options to the partners for terms and conditions can shorten the time required for negotiation.

In close cooperation with DOE, we are making progress toward reducing the non-legislative barriers. We have implemented a number of process improvements that are beginning to streamline procedures and reduce the cycle time associated with processing our Cooperative Research and Development Agreements and other technology transfer tools. Our experience, prior to implementing some of these improvements, demonstrated that the time required to process some cooperative agreements was ranging from 200 to 400 days and even higher for some large Cooperative Research and Development Agreements where the number of collaborating partners required the involvement of multiple management and legal teams. As of May 31, 1995, our year-to-date experience is an average of 85 days which represents a significant improvement over prior years.

We also chose, in December 1994, to conduct, using an external organization, a CRADA customer satisfaction survey borrowing a more business-like approach from the private sector. We engaged the services of an independent third party, IC^2 from the University of Texas, to conduct a written response survey followed by direct meetings with a portion of the respondents. From these efforts to implement continuous improvement we learned much, including the value of the one-on-one follow-up meetings. This spring we have responded to the findings of this effort with specific process changes. Our efforts are best described to be in the category of "More User Friendly" and to conduct our agreements in a more "business-like" manner.

Arising out of this survey and our prior experience are additional changes in legislative requirements and congressional directives that would represent a very valuable addition to the technology transfer process.

(1) Advanced payments continue to be a barrier to smaller businesses and other federal programs. The requirement of advanced payments before work is performed is a barrier to our working expediently with users of our unique User Centers. As it is contrary to standard commercial practice. Since this problem is a budgetary resource issue which cannot be waived, the DOE has initiated a proposed pilot program in which a portion of the DOE budget could become that required budgetary resource. We support the establishment of the proposed program.

(2) While the DOE has granted blanket waivers of depreciation and added factors for small businesses and non-profit organizations, these requirements continue to be a financial burden and we believe they should be discontinued. These factors add

cost and additional bureaucracy to the system, generally provide no real benefit toward asset renewal and add a cost burden to struggling businesses that need to utilize federal resources to achieve their goal to become globally competitive and create American jobs.

(3) In the spirit of Total Quality Management and the process of continuous improvement, change the Federal agency approval times for CRADAs and Joint Work Statements from 90 and 30 days respectively, to a combined total of 30 days for all GOCO operations. While it will be a challenge, the DOE experience gained in processing over 1300 CRADAs in Department of Energy provides the know-how to further streamline.

(4) There is also a need to examine the U.S. competitiveness clause in the agreements we use. While small business readily accept the default position, the U.S. Multinational companies in today's global economy have manufacturing operations that can be seamless with respect to governmental or jurisdictional boundaries. This creates significant difficulty especially in the enormous tracking and accountability task associated with the current existing "substantial manufacturing" clause. We have some flexibility to determine alternative economic benefits; however, to negotiate language that is acceptable to all parties complicates the process and adds to the negotiation time and expense. While we do not dispute the need to preserve the benefits to U.S. economy, we need improved language that is acceptable to a broad group of American companies. It is also of vital importance that any newly adopted language be interpreted and used in the consistent manner by all Federal Agencies. Perhaps a multi agency study group led by DOE could address this problem.

(5) Consider our earlier testimony on Technical Assistance. As Research & Development budgets decline, the availability of projects that support small business will decline. As many have pointed out, these small and emerging companies help drive the American economy from the perspective of job generation and innovation. How the needs of this growing population of small business can be satisfied while meeting the basic DOE mission, becomes an increasingly important issue. One possibility is to propose a new style of State-Federal partnership that leverages Federal R & D Facilities as "Resources-on-Demand" to help reduce the varied problems of the industry within the state in which it operates. Fairness of opportunity conflicts with private sector might be better addressed through this new Federal-State relationship.

(6) Research and Development labs like ORNL are predictably inventive. New inventions at ORNL range within 150 to 200 each year, putting our lab close to the best in the country, that include the University of California, Stanford, and MIT, who all have been very successful in licensing technologies. But accurate prediction of specific inventions or fields of invention is impossible. For some of these inventions, the patents can be quickly bought to commercial application by private industry. Other inventions that are important to existing DOE programs, continue to mature with the progress of the particular DOE project. However, many promising technologies evolve directly from research but which are not needed by the specific DOE program. In these instances, the inventor's technology is a significant event but is of no immediate programmatic value and is too immature for the private sector to risk capital for further development. What happens to those inventions?

(7) Finally, our experience is that successful commercialization of technologies arising out of DOE research may be demonstrated in a few months for software technology but could require a decade or more for new products involving a new material. This is due to a range of factors including the industrial infrastructure required to support a new material. We recognize that there are many times when a gap exists between the investment in research and development and the opportunity for commercial applications development. Perhaps, in some cases, the maturation of technology can be accomplished with the use of royalty funds and will bridge this gap. However, this pool of funding is very limited. We might do well to consider a limited funding mechanism to nurture selected inventions in this category with the anticipation that the maturated technology will be important to U.S. competitiveness or is a significant part of a critical, yet emerging, U. S. technology. Our approach would be to recognize, within the agency, maturation of technology to be an integral part of the R&D mission.

We realize that the relative benefits of the technology transfer and industrial assistance programs in the federal labs is currently a topic of discussion in Congress, agencies and across the nation. These are valid questions and one must clearly demonstrate the relationship to the core mission or the economic and societal benefits realized. One method of accomplishing this is to measure results.

In Oak Ridge we do compile a number of metrics and benchmark with other non-DOE organizations. We measure new companies created, conduct surveys with customers about their plans to market product , tabulate inquiries relative to employment expansion and measure the jobs saved through technological assistance. While the absolute number of agreements are measured, DOE Management and Operating contractors do attempt to measure the overall benefit of projects, effectiveness of the projects and of our course the ultimate impact of improving our nations well being.

The Technology Transfer team in Oak Ridge ended the first half of the fiscal year with a record number of 16 licenses which compares to 17 for all of fiscal year 1994. Our current licensing portfolio consists of approximately 120 licenses and a patent portfolio of over 400 licensable technologies. In our efforts to address the time factor associated with the cooperative research and development process, we have decreased the number of days required more than 50 percent from 1993 and an additional 20 percent in 1995. In the last two years, we have help start 10 new companies. By the end of FY 1994, we had received $3,188,200 of royalty income, and $797,000 of this amount was shared with 470 employees. As stated earlier this incentive program is viewed by our employees as a measure of tangible success and contributes to the volume and quality of inventions produced from the facilities in Oak Ridge. As of May 31, 1995, we have a total of 250 Cooperative Research and Development Agreements. Approximately 38 percent of these agreements are with small businesses. This total CRADA level represents almost one out of every five agreements of this type signed by all DOE laboratories and contractors. Therefore, we believe our experience represents an important part of the total DOE background and perhaps will be of value to other federal agencies and contractors. We have, in the last two years, conducted several customer surveys and sponsored customer feedback workshops. In the spirit of total quality management, we have used the results of these efforts to improve our procedures for developing and implementing Cooperative Research and Development Agreements at the DOE facilities in Oak Ridge. However, the real measure of success comes from the level of satisfaction realized when our work culminates in hard results.

But it is not always easy to generate the specific quantitative measures. In his January 1995 report, Dr. Barry Bozeman of the Georgia Institute of Public Policy states 22% of industry interaction led to a product being marketed. This result is significant. When compared to the industrial sector report generated by Dr. Christopher Freemen who stated that the industrial rate of marketed products was only 10%. In the report by Dr. Bozeman, the time for commercialization

and the generation of jobs is often too distant to measure. However, from a broad prospective, federal labs have made major impacts and the favorable economic benefit can best be estimated by businesses, economists and academia. For example, the creation of a nuclear medicine industry that utilizes over 10,000 measurements every day. The use of uranium enrichment technology in the process of vaccine perfection. Let me expand on that story.

In the 1960's a team of scientists and engineers from the Oak Ridge National Laboratory, the Gas Centrifuge Program located at the K-25 Gaseous Plant, and the Y-12 Weapons Plant combined talents and technology with industry to develop a machine and a process that has since been credited with saving millions of lives a year worldwide. The team, led by Dr. Norman Anderson of ORNL, and funded principally by the Atomic Energy Commission and the National Cancer Institute, developed a process for isolating and purifying virus to create vaccines, most notably to treat influenza. The vaccines produced by the new process essentially eliminated the sometimes severe side effects common with standard vaccines. These side effects were due to an allergic reaction to impurities contained in the vaccines. Severe allergic reaction prevented the administration of the impure vaccine to the young and the old — the very people who needed it.

The development of the solution to this problem could not have been done without close teamwork between biologists, state of the art centrifuge designers, and engineers whose job was keeping people safe from hazardous materials. The close proximity of these scientists and engineers, all located in Oak Ridge, enabled the rapid development of a complete process in a very short period of time. This process development could not have been done without the Pharmaceutical industry who would eventually place the vaccine in trial for certification with the FDA and would produce the vaccine. Commercial centrifuge manufacturers would eventually produce enough machines for worldwide use. This could not have been done without the interest and funding from NCI who at the time were facing the issue of how to make production quantities of virus based drugs if they were needed for treating cancer? The first key piece of technology that enabled the development of the new process was a production size high speed ultra centrifuge. This centrifuge spun at 35,000 RPM producing a sufficiently strong "artificial gravity" (200,000 G's) to separate virus from impurities. The scientists and engineers within the U. S. Gas Centrifuge program were uniquely qualified to design and build prototype virus production machines. The final machine, the K II Centrifuge, was produced and sold worldwide by a private manufacturer once it was certified for vaccine production. Finally, the pharmaceutical industry provided the viral material and testing protocols that led to the licensing of the process for the first truly pure influenza vaccine in the 1960's. The teamwork that led to the development of this unique purification process involved bringing together unique technologies that did not exist elsewhere. Further, the time required to go from the identification of need to operation of the first system with live virus was less than a year due again to the concentration of these unique capabilities in one place — Oak Ridge. There are many other examples of such success at Oak Ridge and other Federal laboratories.

Do technology transfer collaborations have any implications for the future? The answer is an emphatic Yes! The exploration of science and the collaboration between scientists and engineers who generate proof of concepts are the strengths our nation needs to foster leading edge technology applications. Will it be done if Applied Science and Engineering projects are not funded by the federal agency? It is doubtful that industry can support any more than the near term benefits. We need to find the correct mix between R&D benefits, industry collaboration and resources to maintain the systems of federal labs and industry collaborations that are the envy of the world. The technology complex that has been built can always be improved, but it is rich in success if one is interested in learning about them.

SUMMARY

In summary, the legislation addresses specific areas of industry concern regarding the ownership of intellectual property and encourages innovation in the distribution of royalty. These issues do positively contribute to the attractiveness of the Cooperative Research and Development Agreements and the overall effectiveness of technology transfer.

Using our customer surveys as a basis for a portion of my remarks, I have outlined several other barriers which our collaborating partners believe have a negative impact on the Cooperative Research and Development Agreement and technology transfer process. I have provided information on those items we believe would represent a significant improvement to the technology transfer process.

I am hopeful that my comments and observations have been of value today. I thank the members attending this Joint Committee for taking the time to hear our views and for permitting us to share our experience and history with you. Should you require any additional information or discussion, we will be pleased to assist you and the staff of this Committee.

Mr. SCHIFF. Thank you, Mr. Martin.

Because we have a third panel waiting to testify, and after that we have a reception and demonstration from a number of the institutions that the witnesses represent, I'm going to limit questions by the members, including myself, to five minutes each. If there's a burning question after that's done, I'd be glad to recognize members further. But I'd like to begin with the five-minute rule, beginning now.

I'd like to say that the hearing we're having on technology transfer is one issue amid a number of issues that are interrelated before the Congress at this time. And they relate not only to technology transfer as a philosophical goal, but to the existence or the possible termination of certain departments, whether that's the Department of Commerce, the Department of Energy, or other departments, to the specific mission and function of various laboratories.

And I can't help but noticing that of course we have all three of the Department of Energy's defense program laboratories represented on this panel—Sandia, Los Alamos, and Lawrence Livermore.

I'd like to ask a question directed specifically at the defense program laboratories. That is, there is a suggestion that since the three of your laboratories were founded at the time with the mission of developing nuclear weapons, and then preserving nuclear deterrents for the country, that that's all the laboratories exist for. And that, with the downsizing of our nuclear stockpile, there is an inevitable downsizing of these national laboratories.

Or to put it another way, you did what we wanted you to do in nuclear deterrents. And is there really a mission left for the defense program laboratories outside of nuclear weapons?

I believe that there is, because I have met numerous times with representatives of the laboratories and seen demonstrations of other work, as witnesses. I wonder if I could call upon the three representatives to give some brief outline of the kind of work they're doing in what might be termed "today's economy."

I would again start with Ambassador Robinson.

Ambassador ROBINSON. Congressman Schiff, if I may, I think I'll try to take your question head-on. The role of nuclear weapons as a deterrent for the nation will continue, albeit at a considerably reduced size. All three of the laboratories have downsized their research and development efforts in nuclear weapons by 50 percent since the Cold War.

We are involved in a wide variety of energy research, in environmental technologies, and in work for other Federal agencies. In our case, it's primarily for the Defense Department in conventional weaponry hardware.

Now, unfortunately, laboratories are not funded by a single line item anymore that comes to the laboratory as they were when they were formed. Now all of the monies that come into laboratories depend upon having a program sponsor that assigns a certain work to be done. And as much as any industry expects results for that, if the results are not forthcoming, those program dollars go away.

And so the discussions that talk about lab closure in terms of making a decision about laboratories doesn't really plug into the system the way it operates. If you want to shut down programs,

laboratories will respond, and grow or shrink as appropriate as the work in those programs is terminated.

But the route to downsizing is through the program dollars, and not to a decision of what I'd like to do in a particular laboratory.

Let me give an example to close this discussion of Sandia technologies for nuclear weapons. As you know, we're responsible for the arming, fusing, and firing, which has required a level of reliability in electronics that requires that there be no greater than a part in 10^9, a part in a billion, of error in the system. Those levels of reliability are unheard of any industry.

As we look to a downsizing of the production capabilities for the country for nuclear weapons parts, we're going to be getting those parts from U.S. industry. Industry was not prepared to deliver to those levels. So one of the greatest technology transfer activities has been to try and transfer reliability technology to the vast number of U.S. manufacturers of electronics.

As they've gotten that technology, they've told us, there's a great competitive advantage to them to be able to offer their customers reliability of electronic hardware at those levels. Be it for phone systems, Internet communications, this level of reliability is something of value.

Mr. SCHIFF. Excuse me. You're talking about reliability in consumer products now, is that right?

Ambassador ROBINSON. Yes. Taking the same technology that was developed and applying it to consumer products gives them a leg up on foreign competition at the same time they become suppliers to us in the future of the nuclear weapons complex.

Mr. SCHIFF. My time has expired, but I'm going to ask, since I referred to all three Defense Department laboratories, Mr. Cochran, and then Dr. Lyons, would you like to briefly respond on that issue, please?

Mr. COCHRAN. Let me just respond with a couple of sentences.

As you pointed out, we did start as a nuclear weapons laboratory. But even then, we were involved in magnetic fusion energy which has grown over the years. We were involved in bioscience.

And so by the time that we had been in business for a couple of decades, we were a very multi-purpose laboratory, to the point that today, about half our funding comes from other nontraditional defense sources, so that those contribute to the technical capabilities that we have. And those technical capabilities are what dictate the program areas that we get involved in.

From our standpoint, give us the program objectives that you want us to achieve, let us know what the pace of that activity should be, and we'll size the lab to meet those objectives based on our technical capabilities.

Mr. SCHIFF. In other words, the laboratory responded to the nuclear mission when it was given that mission, and could respond to other missions if they are assigned.

Mr. COCHRAN. Precisely.

Mr. SCHIFF. Dr. Lyons?

Dr. LYONS. Mr. Schiff, I referred to the fact that we regard our central mission at Los Alamos as reducing the global nuclear danger. That mission may change a decade, two decades into the fu-

ture. But for now, we believe that is an absolutely compelling mission that the country needs.

My colleagues have described how that relates to the various stockpile, support stockpile integrity aspects. Let me just note a couple of things that they didn't mention, that also ties in with the need to look at environmental restoration from weapons activities of the past.

It ties into very important activities in nonproliferation, and counter-proliferation. And it ties into important areas in management of special nuclear materials as they're recovered.

And let me only additionally add that we're to the point at Los Alamos, from the perspective of reduced budgets within that central mission, that we absolutely now are relying on a range of other missions where we can contribute, in the civilian area, in some Department of Defense missions, and very much in industrial partnerships, to create the overall intellectual vitality, the scientific excellence, that's required for a lab like Los Alamos to continue to fulfill its mission.

Mr. SCHIFF. Thank you, Dr. Lyons.

Mr. Tanner.

Mr. TANNER. Thank you, Mr. Chairman.

I'm sorry I've been out. But anyway, thank you for allowing us opportunity, and we're delighted to have your testimony. I've read through many of your statements.

I wanted to ask Mr. Martin, if I might, on page 2, there's a sentence of the testimony from Oak Ridge. "The transfer of know-how from the laboratory depends primarily on our researchers' interaction with the private sector."

I wanted to ask you and really your colleagues, if it's applicable, what has been the increase of the public/private partnership over the past five years, say, and who generally initiates CRADA discussions and other ideas? Is it you all? How does that work, in furtherance of this statement?

Mr. MARTIN. Congressman Tanner, there's been a significant increase in all the laboratories in the last five years. Last year, for example, at our laboratories, the number of users of our facilities, the university and industrial researchers——

Mr. SCHIFF. Mr. Martin, please excuse my interruption just for a moment here.

No doubt you heard the bells go off for a vote. I want to advise the members that, because we have another panel to hear, Mrs. Morella and I are going to endeavor to keep this hearing going as long as possible. So members are advised to vote at their discretion. They will be recognized after the vote, if they've not been recognized.

Excuse that interruption. Please go ahead, Mr. Martin.

Mr. MARTIN. I grew up next door to a fire station, so I understand this.

The number of researchers at the laboratory last year that were there for a period of two weeks or more was almost equal to 50 percent of the total professional staff. The cooperative agreements known as CRADAs, which we didn't have five years ago at the laboratories now, are about 250.

The amount of licensing we have done, we probably did as many licenses in the last six months as we did all of the year before. So that's rapidly increasing.

The question, who initiates those? They get initiated in a lot of different ways. Some were initiated because the agency has initiatives which the government has chosen to pursue. So some of those are started by the agency itself. Many of them are started as a result of awareness programs. The private sector is saying there is a unique facility, or there is a researcher, or there is a technology we'd like to learn more about.

I would guess, more times than not, that it's initiated by the private sector.

Mr. SCHIFF. Dr. Lyons.

Dr. LYONS. Let me first agree with each of the comments that was just made, but also give you one specific example of still another way that we're seeking to create partnerships.

Los Alamos has been in the press lately for some very dramatic breakthroughs in high temperature superconductivity. That's a case where the laboratory has developed what we believe will be a truly revolutionary technology, and we're being inundated with companies who would like to partner with us.

In this case, the approach that we're taking is to advertise a meeting in Albuquerque, which will take place July 5, 6, 7, inviting a number of U.S. companies to discuss with us different ways of moving ahead with commercialization of this technology.

So that would be an example where the initiative, if you will, is coming from the laboratory perspective, but very much focused in a way that it becomes an outreach effort to U.S. industry, trying to structure mechanism, actually in this case where we can involve a number of companies, as opposed to providing benefits to only one or two. That's simply one example.

Mr. MARCZEWSKI. Mr. Schiff, if I may speak.

Mr. SCHIFF. Please.

Mr. MARCZEWSKI. I'm a newcomer to the National Renewable Energy Laboratory, have not been there yet two years. As a matter of fact, in my current capacity as the technology transfer manager, I've not even been there two months.

So I'm going to speak about my experience in industry, where we specifically went out to mine the gold nuggets, I'll call them, in the national laboratories.

And so in response to your question, who initiates the best contacts? My experience says that when an industry makes a strategic decision to go after the technologies developed in the national laboratories, those are the partnerships that work and will create value for that industry.

Other mechanisms that work very well are the Federal Laboratory Consortium in its outreach programs to industries, and the regional tech transfer centers that they manage make a successful impact on tech transfer.

But it's when industry comes to the laboratories with a shopping list, looking for very specific things, is when we have the best opportunity for collaborating.

Thank you.

Mr. COCHRAN. As you've already heard, there's really no simple answer to that. It depends on the technologies, and it works both ways. Many times industry will come shopping at the laboratory for particular needs.

But in our case, we're finding that we are achieving a great deal by reaching out to industries, something we didn't do much in the past. And that's starting to have real benefits.

We publicize more widely the patents or patent information that we're developing. And in the case of one of our major projects that we're working on, a national ignition facility, we've had meetings with hundreds of suppliers who would supply parts for that facility that goes forward. So they can work with us to develop the particular kinds of technical equipment that we need so they can supply them.

So in that case, it's really the laboratory saying, "We have this need."

The same kind of thing happened in the supercomputer area. So it really depends on the technology. And I think the thing that should happen is for all of us, both the laboratories and the industry we're working with, to work much harder to make sure that people know what is available, and what the needs are.

Ambassador ROBINSON. Let me just comment. I agree fully. Industry-driven partnerships are what makes sense to add value to the commercial sector. We at the laboratories will worry about making sure that it fits within our programs and pays the dual dividends.

One example is some work we did with Motorola Corporation on trying to eliminate CFCs from the manufacturer printed circuits. It was very successful, and when it was announced, a large number of other companies wanted to access the technology. We finally set up a group with 400 U.S. companies to access the technology, so it can be used nationwide.

In that process, the industry people speaking together, and with us, suggested, well, their even bigger problem is lead that's an inherent part of the soldering process for all circuits. That makes it difficult to dispose of any electronics parts in landfills. Could you please work on that?

And I'm happy to report, knowing this was their most important problem, within the year, this team was able to find a solution and demonstrate lead-free soldering which is now being transferred throughout those 400 companies. It should be an industry drive to make it mutually beneficial.

Mr. SCHIFF. The gentleman's time has expired. If the gentleman wants to follow up briefly.

Mr. TANNER. If I could impose, I thank the Chair.

I would ask that if any of you have any ideas about the question I asked the first panel, any way to measure our success in this area so that we can convince some of our colleagues of the wisdom of these programs? I think most of you were here during the Panel I. I won't take a lot of time to rephrase it. Does anybody have a comment?

Ambassador ROBINSON. I would comment, listen to industry. And maybe it is good for us to get off the stage and let you hear—the last panel I think are industry participants—are the customers'

needs being met? Do they believe that it is making their companies, and hence the U.S., more competitive in international markets? I would put that as metric number one.

Mr. MARCZEWSKI. I'll offer you a second metric. Does the customer come back for repeat business? Check to see how many times they do.

Dr. LYONS. Let me offer still another metric, that it is also critical that we evaluate these partnerships from the perspective of their mission contributions to the laboratory. For that reason, at Los Alamos we're involving folks from our nuclear weapons program directly in those evaluations of our programs.

These are alliances. These are partnerships. There have to be two people coming to the table. It's critical of course that industry does benefit. But it's equally critical that there be a mission benefit for the CRADAs.

Mr. MARTIN. Briefly, we track about 50 different metrics and tech transfer at Oak Ridge. We try to aggregate those to a few over-reaching ones. One that Pete has just mentioned, and has caught our partnership involvement index—and it essentially measures in a very simple way how the private sector partnership is leveraging the mission work of DOE.

We back that up with support documents as to why we do the program. And then we have process metrics as to how well and how efficiently we went about that process.

And finally, it seems to me, that you do have to go out and try to assess what we call the collateral benefits. That's what happens to that technology when it goes to the private sector. What are the investments, and wealth, by the private sector to the business? What are the jobs created? What benefit does that have to this country?

We'd be happy offline to share a number of these metrics with the Committee if it wishes to do so. Thank you.

Mr. SCHIFF. The gentleman's time has expired, and so has ours, to reach the vote here. So I'm going to declare a recess for about 10 minutes.

[Recess.]

Mr. SCHIFF. I'd invite the witnesses to return to the witness table.

I'd like to recognize Mr. Baker for a round of questions.

Mr. BAKER. Thank you very much, and I'll try and be brief because we want to get the third panel on and hear from industry.

I don't know who the first one was that said this, but I know the last one attributed to it was Dick Armey, that "Those who love peace more than freedom will lose both."

So I'd like to suggest to Mr. Tiahrt before he has his lab closure bill with seven honest civilians, I want to know which the politicos are qualified to evaluate the efficiency of the SDI program, and what we're going to do about the scuds in Iraq and nuclear secrets in North Korea, and what China really has up their sleeve, because they're still a very closed society with a billion people and a tremendous military capability.

The labs' role was nuclear. It is still nuclear. We want to expand that role into the private sector because a lot of those secrets have civilian possibilities.

We also want to get business involved in the laboratories so that they will be more market driven. But it's going to take more than just euphemisms and promises. We're going to have to do it.

So my first question is, what about the current relationship between the Department of Energy and the laboratories? Can we get a CRADA or cooperative research agreement or just any kind of an agreement through DOE in less than a lifetime?

Anybody can answer that. I want to move really fast.

Mr. MARTIN. Quickly, I think the answer is yes. There have been great improvements over the last couple of years with the new modular CRADA concept, the new small business CRADA. So all the Federal laboratories times to complete CRADAs has been dramatically reduced.

We have said in our testimony that we would also offer that even in the case of the government-owned and contractor-operated laboratories, perhaps you would like to change the legislation so that there is a total of 30 days' approval for the total CRADA process, as opposed to the 60-30 kind of thing now for JWS and CRADA. And that would be a further improvement.

I think the experience within DOE allows us now to do those things in a much shorter period of time, both the JWS and the CRADA.

Mr. BAKER. When you're dealing with very, very large corporations and their batteries of attorneys, I think you have to give the government a slight chance. Thirty days may be too short if you're signing a hydrogen fuel contract with Texaco.

Mr. MARCZEWSKI. I was just going to add that I agree with the point that the times have been reduced. We're seeing times now that, in the past it was taking a year and a half or two years—horrible stories. And now we're down to a month or two or three time frame, depending on the difficulty of the deal.

So we think that major progress has been made. And that's really not our primary difficulty at present.

Mr. BAKER. Dr. Lyons?

Dr. LYONS. We maintain an interesting chart of Los Alamos that I'd be more than happy to send you a copy of, in which we plot the average time between a joint work statement and CRADA execution as a function of when the CRADA started.

And indeed, if you look back in the earliest days of CRADAs, you've got points up here around a year. And if you look today, we're now averaging in the 40 to 50-day range. And that's through a whole host of improvements within the Department, and within the laboratories.

I don't believe the time to get a CRADA in place is usually the major problem. Now, there are some cases, though, as you pointed out, where you've got a battery of lawyers who are particularly concerned with some details. But I'd be happy to make that chart available, and you might find it useful.

Mr. BAKER. Thank you.

Mr. Marczewski.

Mr. MARCZEWSKI. Mr. Baker, I've got to say the Department of Energy is not the impediment anymore. When we talk about batteries of lawyers, it isn't the fact that they've got a battery of them. It's that they change the batteries all the time.

And so the first thing we need to do is educate those attorneys from the private sector side what we can and cannot do. But as far as at the National Renewable Energy Laboratory, once that education process is behind us, the DOE's not the holdup. Our laboratory's not the holdup. Usually a week, 10 days, and it's through our system.

The only thing I might also add, though, is sometimes the holdup is lack of funding. And so we need help in those areas, also. Thank you.

Mr. BAKER. That's the major thrust of my concern with technology transfer, is that we have reduced dramatically the budget in this area this year. As the military budgets continue to be constrained, so might the laboratories.

So I'm anxious for you to get into the marketplace, not because I want you to sell your souls or your services, or just become market-oriented to do that. But I think the future clearly is in the communications, the medical, the energy, the other fields that you're going to fall into because you have such a reservoir of technology expertise, equipment.

For instance, Livermore that I'm familiar with is a renowned laboratory for lasers. And they'll be able to market lasers anywhere. We just have to do it.

So I want you to get out there in the marketplace and provide another stool for the ladder so that Mr. Tiahrt and his goofball idea won't find any audience in this Congress.

Mr. MARCZEWSKI. Mr. Baker, maybe I could graphically show you the dilemma that the laboratories are facing, and Mr. Tiahrt's concern about moving technologies from the laboratories into the marketplace, or getting value from the technologies, because if you think about it, there is no value added in creating technology for technology's sake. It's when the technology starts doing good for the country.

And I can show you graphically, very quickly, if you would allow me.

Mr. BAKER. All right. You can't have a laboratory expert without an overhead. I learned that my first visit, and I've been there 100 times since. [Laughter.]

Mr. MARCZEWSKI. I want to talk about something briefly. It's called the technology maze. I call it that because when you think of technology, research and development, it really falls into about five categories, the first one being basic research. Somebody someplace says, "Aha. I think I've discovered something."

And then that person says, "I need to find out whether really I've got something."

So they go into the second phase of the research, called focused research. So what you do is, you assemble the team of experts in that field, say "What I've discovered, does it really work?" And those people work at that discovery—"Yes, it does."

So then we go to the next phase, the third phase. The third phase, I call that a proof of concept, but also we call that applications. What happens now is, we get a bunch of people together in a laboratory working at a bench someplace, and we make one, something.

Then what happens? All of a sudden somebody out there in industry, either through a publication or a meeting, announcements, in industry says, "You know what? They've got something over here. I think it could have some value to us." And all of a sudden, we go into a phase called "validation."

Now, all this time, the players are changing, and the focus of what they're trying to accomplish is changing. And what's happening here is, you've got universities and national laboratories providing most of the work.

But as you're moving this way, all of a sudden industry begins to discover, there's something here. And then they begin to validate it for robustness, get it ready for introduction in the marketplace.

And finally the technology is ready, and you're at a decision point. Industry decides, "Should we take it to market or not?" And if they do, they enter phase 5, and I call that insertion. Some people call that commercialization. But you've got to go through all five phases.

But what you've also got to look at is, there are many ideas in, few ideas out. And it keeps narrowing, narrowing, narrowing down. So that by the time you get to this point, many things have been accomplished during that period of time.

Another interesting thing happens at this point also, when you look at the funding. Changes appear here. So if you want to look at it graphically——

Mr. BAKER. Your government funding is highest at the beginning, and reduced at the end.

Mr. MARCZEWSKI. That's what you've got. You're looking at somewhere around 100 percent of funding. And basically, this is all government. This would be industry.

And if we look, industry gets involved about here. Industry picks up here, and goes like that.

What you've got—we start talking tech transfer, there's a gap right in this area here where tech transfer funding has to come in place to bridge that gap.

The challenge that the laboratories are facing right now, with the message that we're beginning to receive from the Congress is, "You've got to move this line over." And so the results would end up——

Mr. BAKER. My message wouldn't be that so much. If the taxpayer knew you were going to be reimbursed for that beginning chunk of cash in the end, we wouldn't be so reluctant to continue funding it. And not all products are going to go to commercialization.

But the ones that do, and the large ones like hydrogen fuel, we darn well ought to get some of the return.

Mr. MARCZEWSKI. One more characteristic that's very, very important to understand here, too, is that this all occurs over time, and that from here to here is typically 15 years, and in many industries, from here to here is typically 3 to 5 years. So if you're going from basic research, the "Aha," to the "I think we're ready to take it to market," 10 to 15 years, typical.

And at that point, when industry makes the commitment for really big funds, up to another three to five years, typical, a perfect example is the National Renewable Energy Laboratory.

When it was founded 17–18 years ago we were in the "Aha" stage, and now all of a sudden here we are. You're beginning to see photovoltaics, competitive with grid, wind energy competitive with grid, biomass, just about there. We're probably over here someplace.

Mr. BAKER. Let me cut this lecture short because I only have five minutes. [Laughter.]

My last and final comment is that not all research can be categorized. And this is my real problem with Mr. Tiahrt's suggestion.

Certain things are locked up in the defense budget, like we talked about the Fisher imaging and breast cancer research. We're getting that because of our expertise in X-rays, the fact that we can see things much smaller and much clearer now. So we find cancer when it's still in the calcium stage, long before it becomes cancerous.

This came out of defense technology. You want to see through a building, find your targets and nuke them, okay. We're building that from left to right in your idea—"Aha. I've got an idea. We're going into commercialization." We are a partner. We're going to be a partner in that. We may save 50,000 lives in the process.

We can't exactly put that on a chart. We can't go to a base closing commission and say, "Give us some money and we'll show you. Every few years we'll have breast cancer research."

We can bring a lot of our defense technology forward.

Secondly, there are certain things that are unbranded, like the space lab. We want to go to space because we think we can have medical breakthroughs. But before we spend that money, we'll never know what kind of a commission is going to be able to evaluate that?

Lastly, defense. How much is our freedom worth? Are we going to complete SDI? Does any politician today have guts enough to stand up, or do we have to repeat the mistakes of World War I and World War II by closing our labs, by shrinking, by assuming the world is going to stay peaceful?

There's only 47 wars going on today, and this President could have us involved in all of them. I want a defense capability that's not ground troops.

So I want to thank you all for being here, and for offering to help improve this bill. Otherwise, you're going to be before us each year with a tin cup, hearing long faces saying, "Well, we'd like to help you, but we can't."

I thank the gentleman. Normally, protocol would be I recognize a member from one of our Democratic colleagues. But Mr. Tiahrt, since your name was mentioned at least four times in that last set of questions——[Laughter.]

Mr. SCHIFF. Ms. Lofgren has consented to my recognizing you next.

Mr. Baker, I wonder if I could ask you to preside over a couple of minutes. [Laughter.]

Mr. TIAHRT. Please don't let him out. [Laughter.]

Mr. SCHIFF. I'm just going to the back of the room. I will be in earshot.

Mr. BAKER. The gentleman's time has expired. [Laughter.]

Mr. TIAHRT. I want to thank the Chairman and Ms. Lofgren for allowing me to go at this time, and I want to remind Representative Baker that he and I have the same goofball goals of achieving and utilizing the labs to the fullest extent that we can, to see that we're not wasting any money, and to focus our resources to see where we can see a return from them.

I come from the perspective of the aerospace industry, where we saw a ratio of engineers and scientists to managers as one to fifteen in that range, ten to fifteen on projects. I haven't seen all the org charts or the head charts that I would like to see. But I suspect that the ratio is somewhat different in the labs.

And part of what I want to see is a more effectively run system, lab system. I'm very proud of what the labs have produced. They're very talented individuals. And the information that I have here from Sandia National Laboratory is very informative, done very well. We have a lot to be proud of.

We're just striving in the concept of quality, total quality concept, of never being satisfied with what you're doing today because there is always room for improvement. And I think that's the direction we're trying to go in; and obviously Mr. Baker and I disagree on how we get there. But slowly and surely, I think we're converting him, as you can tell.

I want to say that I'm somewhat frustrated, after reading GAO reports, and seeing how, even within the Department of Energy, we're unable to get new technology transferred to, for example, nuclear waste control, and in other areas of waste control, where it was part of that in the GAO report, the vitrification process where they take multiple wastes and condense them into a glass-like product for storage, has been somewhat, according to the GAO report, which was a little bit old—last September, I think it was.

There's a frustration to see new technology being incorporated in controlling nuclear wastes and controlling other civilian wastes that we have. So I think this process of transferring technologies should not only go between government research and the private sector, but also it should be circulated within the government, because we are very big and cumbersome, and don't yield very often. And I think that we're missing a lot of opportunity by doing so.

So I'm going to go through a series of questions, about three questions here because my time is limited and the gavel is heavy, and then allow you to respond.

One is that I wonder if we can expand to the government, and perhaps Galvin's recommendations with the corporate-type structure—would that benefit that process?

A second thing is, Mr. Martin talked about involving the private sector earlier in the process. Can we do that through a revised CRADA concept, or would this corporate structure that Galvin proposes be effective?

And a third question that kind of sparked my interest was, Mr. Marczewski—by the way, you did solve that problem which has been lingering for me, which came first, the chicken or the omelette?

But the use of best business practices, which I think I would like to see it incorporated in our procurement processes when we buy

things. And also, when we transfer technology, how do they do it within the corporate environment?

I'd just like you to comment. Would the Galvin structure as recommended, the way Bob Galvin seems to be frustrated in getting it implemented—would that structure provide a conduit to solve these problems that we're talking about in technology transfer and other problems?

Ambassador ROBINSON. I wish there were a short answer to the question, particularly now. I think the hardest part of what Dr. Galvin was fighting is, there has grown up in the Department of Energy and its predecessor, ERDA, a lot of bureaucracy over the years. By the way, I don't think anybody in the laboratory disagrees with that, and I'm pleased to see the Department of Energy saying they agree with that as well.

So Mr. Galvin can at least take heart in the fact that people agree on what the root cause is. His proposal for a corporatized structure with a board is to try and put some press back into the system against micromanagement at the bureaucratic level.

I'm not convinced that you in the Congress would really like to put all that power into a board. Otherwise you might recreate the Atomic Energy Commission that used to have such power.

He made a second recommendation that maybe there is a meeting ground, and Appendix B of his report said, "We've got to get government out of the way, the government bureaucracy, and stop micromanagement, and put a lot more authority back in the laboratories to manage."

Our short word for it is "put the M back in M&O," management and operating contractors.

For the most part, the management and operating contractors are corporate organizations. In order to bring corporate models to everything we do, that was the original purpose of having the weapons laboratories not be a part of the government, but have corporate ties, is to get the very best practices that corporations have to offer.

We've been trying to do that. We've been embracing quality methods since they first came onto the corporate scene. We think they're showing a lot of benefit for us. They haven't made their way into the government quite yet.

My hope would be that the Department of Energy can really deliver on that commitment, to try and get micromanagement out of the way. If that's successful, I think we'll all be better off. If that's not successful, maybe the agency should be abolished.

Mr. SCHIFF. The gentleman's time has expired. But since Mr. Baker gave kind of a philosophical summary at the end of his time, if the gentleman wishes to do the same, or ask another question or two, I'll continue to recognize him.

Mr. TIAHRT. I think we have started the process, and I'm not sure what broke the logjam. But to hear you talk about looking at best business practices, at trying to streamline your management decision processes, I think even a large corporation has seen the frustration of bureaucracy growing so large you're unable to respond.

I think that's probably where we're at in our structure within DOE, and perhaps within some labs, although I don't know the de-

tails well enough yet. But if we go through that downsizing process, or "rightsizing" as some corporations have put it, and streamline the decision process most of all, giving the authority to a lower level, and then letting it work.

At least integrative product teams were a good concept. But if you let them come up with a decision, and then override that decision, then they become useless.

So I think if you look at these best commercial practices, what's working outside, and incorporate it in the laboratory, we're going a step in the right direction. And I'm glad the logjam is beginning to break.

Mr. MARCZEWSKI. Mr. Tiahrt, let me add something to this. You specifically addressed another question here. The Galvin commission, we basically agree with what's in the Galvin commission. There's one area, we talk about best business practices here.

A very good business practice is actually to take a technology, look for capital in the capital market, in the venture market, spin that technology off.

We at NREL are in the position to do that kind of thing, with a specific technology in biofuels—spin it off as an independent venture.

We also have a disadvantage. When you think about some things that are in our contract, if you want to talk about best business practices, we talk about incentives. There are disincentives within our contracts that don't allow us to benefit from spinning off, from commercializing, from giving value for the nation.

As an example, we're limited in royalties and other income to five percent of our budget. Anything over five percent, seventy-five percent of the overage goes back to the Treasury.

In these times of shrinking budgets, why shouldn't a laboratory be able to take every resource that it can find to try to maintain the core competencies within that laboratory?

So we support Galvin. We even would push it further. Thank you.

Mr. COCHRAN. I just want to make one comment, if I could. We certainly embrace using best business practices. We encourage the government to keep pushing in that direction because we welcome it.

And if you will do that and then give us a chance to in fact work this out and straighten it out ourselves, I think we are capable of making that happen and producing something you'll be satisfied with downstream.

So we'd like that opportunity.

Mr. SCHIFF. Dr. Lyons.

Dr. LYONS. Three quick points, if I might. The introduction of best commercial practices into the laboratories is one of the areas where we think industrial interactions and industrial alliances can be particularly effective, as we start to better understand how industry is working, and we start to benefit from their successes, point one.

Point two, something that Los Alamos has just started recently is an industry fellow program, where we're placing people out in industry on one-year assignments. Again, from the standpoint of exactly as you were suggesting, better understanding, best business

practices, understanding how industry does need to function to bring products, how best to integrate national laboratory interests with that.

And still a third comment, which you might find interesting, as far as how many managers or how many employees report to how many managers.

At Los Alamos, Sig Hecker has 28 so-called directors, of which I am one, reporting to him. And the genesis for that type of arrangement came from a CQI process at Los Alamos, visits to the Motorola Institute, et cetera.

So please recognize there's some hope.

Mr. TIAHRT. Good. Thank you. I just want to say that if there is a suggestion that you have that needs some legislative thought, and perhaps action, my office is open. We would like to facilitate the process.

Thank you, Mr. Chairman, for your indulgence.

Mr. SCHIFF. Let me just say for a moment that although, Congressman Tiahrt, I don't share your view that there ought to be a lab closure commission, because I've already seen deficits in how the closure commission works with the military, I did not want to apply to a brand-new, unprecedented area.

All of your views towards wanting all government agencies, including national laboratories, to function on a more precise basis with missions clearly defined, and with accountability, I fully share and want to work with you on that.

Ms. Lofgren.

Ms. LOFGREN. Yes. I wanted to ask a question on kind of a different note. From time to time, I'm a freshman in this Congress, and I've seen decisions made based on newspaper stories and anecdotes sometimes.

And I wanted to give the panelists an opportunity to comment, if they have seen the series of articles in the Philadelphia Inquirer that ran earlier this month that basically focused on technology transfer programs, and depicted them as not useful, to use a kind word, or scamming, to use another, and really focused on the role of the labs, not exclusively, but heavily.

I wonder if you have comments about the accuracy of the report. Can you take this time to tell us what the truth is as you know it, if it contrasts with that?

Ambassador ROBINSON. I have been interviewed by the press for at least 20-plus years. I was interviewed by those folks on a lot of topics. I have seldom seen my remarks taken so far out of context, uniformly. I wish I could discern what was the purpose that they had in mind. I read all the articles, and I couldn't conclude—they must have done this with a purpose—what were they trying to do?

And it still is obtuse to me.

Ms. LOFGREN. I don't know what the motive was, but the program wasn't funded, so that was a result.

If you have specific, I mean, I'd like to hear from each of the panelists here in public. And if you have specific errors that need to be pointed out, I would love to have it in writing later. I'm sure every member of Congress would want to know the truth of the matter.

Mr. MARCZEWSKI. Ms. Lofgren, I read the entire series of articles, and one specific section that I can take exception with—I mentioned I'm from industry. I spent 26 years with General Motors, my last 4 or 5 just looking for technologies within the national laboratories.

And the whole section there with General Motors needs a rewrite. Not only is it inaccurate, it's worse than that.

Dr. LYONS. I think if any one of us who was interviewed for that article as I was attempted to respond to the inaccuracies, you likely would be sitting here a very long time. I'd like to accept your offer of submitting written comments. The Department has been collecting those comments, so each of the labs does have something, I believe, that could be transmitted quite quickly.

I'd appreciate the opportunity to do that, but if I respond orally, we'll be here far longer than I think you'd like.

Ms. LOFGREN. And that's fine.

Mr. COCHRAN. We feel that much of the Livermore information was badly misrepresented, and we have provided comments to DOE which we will be happy to share with you, which clarify those points.

But I share the sentiments you've heard from the other panelists.

Ms. LOFGREN. Thank you.

Mr. MARTIN. My brief summary would be that, from our vantage point, for the articles that they refer to some of our projects, that what was reported was incomplete, more incomplete than incorrect. And if you added what the purpose of the DOE in doing those projects, it would have taken a different perspective and a different answer.

Ms. LOFGREN. Thank you very much.

Mr. Baker.

Mr. BAKER. Thank you, Ms. Lofgren.

Ms. Jackson Lee.

Ms. JACKSON LEE. Thank you very much.

Gentlemen, if you might indulge me for a moment, and work with me on some of the concerns that may have already been stated, I apologize for being detained on the House floor.

What do you see as the chief obstacles that are created between the cooperative research and development agreements and particularly as we relate to this whole question of transfer? What have been the obstacles that you would see that would impact this that we may not have already herd, or maybe that I might have missed?

If you can share that with me, I'd appreciate it, from—I think I was looking at you. Is Dr. Marczewski here?

Mr. MARCZEWSKI. Some of the concerns I have, as were submitted for the record, with the Technology Transfer Improvement Act of 1995, is mainly the area of exclusivity. There is value to providing an exclusive license to an industrial partner. But to mandate that it should be given to the partner at the partner's option is not always in the best interests of the country.

Some of the areas for improvements in other things, some of the agencies owned the intellectual property rights to inventions that their laboratories have developed, and the agencies are willing to provide those licenses to industry virtually free of charge, if they don't ask for an exclusive license.

Well, as I mentioned earlier, there is value to exclusivity. The problem, when you ask for exclusivity from the agency, it's difficult to get that.

My suggestion would be that the agencies waive intellectual property rights to the M&O contractors, allow the M&O contractor then to negotiate in best faith to grant a degree of exclusivity to an industrial partner, maybe in a specific field of use, maybe in a geographical area.

But the industrial private sector needs exclusivity so that they know, when they get a license to a technology, and they do the additional development that it takes to get across that fifth area of research and development, as I was pointing out earlier, that their competitor can't come right in and immediately benefit from their research.

So those are some of the areas that I would make suggestions for improvements.

Ms. JACKSON LEE. You make an interesting point. I would appreciate comments from the other gentlemen there. You seem to be suggesting a balance because I might be concerned that we are giving a governmental benefit to one in the private sector to the exclusion of others who may be able to benefit.

I use a local example that certainly is localized maybe to local jurisdictions. It's called the taxi medallion. It allows people to drive taxis. And one person gets it, and they can then issue out opportunities for others to drive taxis.

But that medallion, which is just given by way of a permitting process, can be valued at $30,000, $40,000, $50,000, which is a lot in terms of having an asset that you can then sell. And it came only because you received a permit, an exclusivity to a certain extent. And you now have value that the government has given you. And you have in turn really not given much to the government.

So, if I hear you correctly, it is try to strike a balance. And possibly you might isolate exclusivity, so if another entity comes in and wants to use it somewhere else, it is still not prohibited. Is that my understanding?

Mr. MARCZEWSKI. That is correct. You can offer exclusivity in a very specific, narrow field of practice, a possible exclusivity for a period of time, a possible exclusivity in a small geographical area, things of that nature.

My concern is that a tremendous amount of intellectual property exists within the agencies. But since exclusivity is difficult to grant, the society is not benefitting from that. People are not electing to try some of those technologies.

Ms. JACKSON LEE. Mr. Cochran, what do you think? And I guess the other side of the coin is, they're not benefitting them, but would be keeping others out of the inner circle by that focus.

Mr. COCHRAN. I think the balance is just right, because what you need to do is, if you have a situation where a company needs to invest a lot of money to complete the development, they may have certain rights or certain expectations for exclusivity which may be very fair.

On the other hand, if there is a technology that is well developed, like a miniature radar we have, in that case you want to get the technology out to as many companies as you can, because they

don't have to invest a great deal of additional money to make it marketable. So there you don't want an exclusive license except in the field of use. You want to spread it as wisely as possible.

So it really depends on the particular situation and achieving that balance.

Ms. JACKSON LEE. I see Ambassador Robinson is interested in answering.

Ambassador ROBINSON. We have tried to walk that line in the direction of balance. After some early experiences with our licensing, if it is laboratory technology, without having patent holders from one of the partners, we will seek to get a limited exclusive license to two companies as opposed to only one.

We found the experience from the auto companies, among many companies, won't put a component into their own product unless there are at least two independent suppliers. It restores the competitive marketplace. You're not held up on price.

You also can be sure people won't sit on the technology and require you to use those march-in rights.

So we've been getting exclusive licenses to two, but only two, in a given field of use, to guarantee that the competition and the value of the marketplace does continue.

I suggested a few corrections in the testimony to fix some of those. But I think the corrections were small.

Ms. JACKSON LEE. Let me follow up with another question, Mr. Chairman, if I may be yielded another minute.

Mr. BAKER. Can you ask a one-line question? Then please be my guest.

Ms. JACKSON LEE. Thank you, Mr. Chairman, for yielding.

In the previous panel, the gentleman was kind enough to be honest to indicate that his career pattern did not necessarily lend itself—and he was now before me talking about technology transfer. So he gave me some hope that this is something that shouldn't frighten Americans, and that we should be able to go into our local neighborhoods and schools and institutions and say, "This is valuable for America, and you can do it, too."

Help me understand how we can create that base. Of course, I might be saying minority contractors. But let me just say small businesses that may in fact be able to participate in this process. What can we do to encourage that, so that this does not become in the minds of Americans, "Oh, that's the big company. That's the IBMs of the world, or that's the other Aerospace of the world," without calling out any other names.

But in any event, how do we translate this into what I'd like to see it be, which is a whole new world of industry for even the small business community?

Ambassador ROBINSON. Technology assistance is one of the parts of the program that is most valuable. And it only works for small and medium sized business, as we've set up the programs. It is now only operating within three defense laboratories. But it allows a request by a small business person who has a problem to have laboratory expenditure up to $5,000 for one question.

Now, if you look at small business, usually it was founded by one or two people with expertise in certain limited fields. And if early

in their work, they encounter a problem that lies outside their field of expertise, they're in real trouble.

And quite often, we are able to give them help, often with a phone call. We operate something called the machine tool hot line, a 1-800 number that people can call when they are in a problem.

The letters keep coming in. "You've saved our business." And particularly, small business are the most vulnerable. If you can get them the technology at the time they need it—and these are always under two-week returns—I think it's a tremendous return from a nation's laboratories.

Mr. COCHRAN. In addition to that assistance, we have a program at some of the laboratories for small business CRADAs, basically, small value CRADAs. Those can go up to about 50,000. A number of our small businesses have found this very useful. In fact, at Livermore, about a third of our CRADAs are with small business.

Mr. MARCZEWSKI. Ms. Jackson Lee, there's another concern that I have, though. When you talk about small businesses, you're talking about businesses with less than 500 employees. You have owners who are concerned with making Friday's payroll.

For the most part, they're not in the technology development business. So how can we provide them assistance?

Well, as Ambassador Robinson pointed out, through this $5,000 limited assistance that they can offer them. Five thousand dollars doesn't go very far, Ms. Jackson Lee.

If you think also about the technologies that have been developed in our national laboratories, they are so early in their development phase, it takes a very specialized research type small business to take it the rest of the way.

So where can we add value to the bulk of the small businesses? It's by going further down that development chain, so that when we hand it off to the small business, that person can actually have value for what he or she receives.

Dr. LYONS. Let me partially disagree with my colleague from the standpoint that I more agree with Ambassador Robinson's comments, that in many, many cases we find the $5,000 technical assistance does answer a particular problem that a small business has, but also in many cases the technical assistance then grows into a CRADA, a small business CRADA of some sort, and frequently into a longer-term relationship with the small business.

Los Alamos, like the other labs, has many, many interactions with small businesses. We find licensing is particularly of interest to small business. About 60 percent of our licenses are with small business. CRADAs, about 40 percent with small business.

And many, many interactions that involve different small business grants with various programs or laboratory expertise helps people write SBIR grants or STTR grants to try to help small businesses.

But I do share your concern that small businesses very much need special treatment, and would encourage additional help along that line.

Mr. MARTIN. Just one added comment. The needs of small industry are so much different from the larger companies. The larger companies are interested in projects that will leapfrog, that will take them down a path. They have got the capability of investing

capital. The small businesses want to fix it tomorrow and get on with it.

And all those programs where there are CRADAs, technical assistants working with them at SBIRs or STTRs, are short-term events with the small industry.

But what it really takes from the Federal laboratories is for each of the Federal laboratories to be very proactive in working with the small business community.

I will share with you something that Joe had said earlier in the earlier panel. About a year ago, we formed a minority tech transfer consortium with about 20 companies. And we were fairly proactive in putting that group of people together. This year they are meeting again in August, and there are 55 minority companies coming in, all involved in the manufacturing of a product. That will meet for two or three days looking at this process of technology transfer and what they can do with it.

So each of the labs is proactive in different areas and different projects, and small businesses. And a lot of that's going on.

Ms. JACKSON LEE. This joint venturing is certainly a key. Thank you very much. Thank you, Mr. Chairman.

Mr. BAKER. Thank you very much.

When we return after the vote, we're going to switch from Panel II to Panel III with a big thank-you to Panel II.

As you can see, we're kind of divided on the issue, too. So your input is vital.

If we can have Panel III come forward, we're not going to recess. We are going to get Panel III so we can get to the reception as close to 5:15 as we can. If we can reconvene, because we want to have everyone go to the reception and see the products and mingle with the committee members that hopefully will be there.

I'm going to ask that we begin immediately. I apologize to everyone for not having adequate breaks, but I have to run and vote as soon as the chairman returns.

Panel III witnesses are representing companies which have developed new products and applications with federal laboratories. The witnesses can testify from an industry perspective to the process of first-hand interaction with federal laboratories. They can also discuss their personal successes and failures of our federal technology transfer policies.

Since we didn't allow opening statements, I would just ask a few questions to get you started. Then you take off from there, if you will.

STATEMENTS OF THOMAS F. FORTIN, VICE PRESIDENT, RIO GRANDE MEDICAL TECHNOLOGIES, INC.; WILLIAM ELKINS, CHAIRMAN AND DIRECTOR OF PRODUCT DEVELOPMENT, LIFE ENHANCEMENT TECHNOLOGIES, LLC; MICHAEL G. URY, VICE PRESIDENT, RESEARCH/DEVELOPMENT, FUSION LIGHTING, INC.

Mr. BAKER. Starting with Mr. Ury from Fusion Lighting.

What was the market analysis of the sulfur gas lights? How did you stumble upon this?

Mr. URY. Do you mean the invention or the market plan?

Mr. BAKER. The market plan. After you found it, how did you get it out?

Mr. URY. Fusion Lighting is a spinoff of Fusion Systems Corporation. Fusion Systems is now the largest manufacturer of ultraviolet lighting in the world.

Part of my R&D plan was to explore the same technology that led to microwave-powered ultraviolet lights, to see if we could invent a better form of visible lighting, and open up new markets for our company.

This started in 1986. In 1990, we achieved a breakthrough. We discovered that sulfur, when excited by microwave energy, created a light which simulated sunlight, with quite good efficiency equalling the best that was available at the time.

Then our problem was what to do with it, how to develop it, and how to get it to the marketplace.

Mr. BAKER. What time did you come to the laboratory with this?

Mr. URY. 1992, I approached DOE after making several attempts at commercial sources to obtain capital. I'd spoken to EPRI, the Electric Power Research Institute. Their pockets were empty at the time. They in fact suggested going to the Department of Energy, gave me the appropriate names at Arthur Andersen, who was running a lighting program.

Fortunately, we're located in Rockville, Maryland, so it wasn't a long trip. And I came downtown and spoke to them.

Mr. BAKER. And you found a laboratory as far away as you could in Berkeley that had the equipment and the expertise?

Mr. URY. Correct. Actually, Dr. Andersen suggested that we go to the Lawrence Berkeley Laboratory. At the time, DOE could not fund us, but they pointed out that they had been funding the Lawrence Berkeley Laboratory for many years, a lighting lab which was doing similar work to us.

They had not discovered sulfur. They weren't fortunate enough. But they were working hard on other paths that hadn't turned up much pay dirt.

What we did was establish a cooperative research agreement as quickly as possible. The idea was to redirect LBL to work on sulfur, to drop their present research. And they were turned around extremely quickly.

The agreement was put in place. I think the final paperwork was signed in seven months. But in about three months, on a handshake, LBL was actually doing work on a project.

Mr. BAKER. And they're partners, are they?

Mr. URY. They are partners in the extent that we now have a license agreement. They filed a patent. The patent's been filed worldwide.

Mr. BAKER. And you're both patentees, or just the laboratory?

Mr. URY. In this case, the laboratory is the sole inventor. This was a patent on an improvement to our product.

Mr. BAKER. I'll turn this over to Mrs. Morella now and go vote. I'm interested in this area only in that it will help support the laboratories in the future, as well as you in the future. I appreciate your comments.

Mrs. Morella.

Mrs. MORELLA. I'm sure you did a very capable job of handling this, Mr. Baker.

This has been a great hearing. I appreciate the understanding of the panelists, because we have the foreign operation appropriation, and I spoke on a couple of the issues, as a number of others have, too.

I wanted to welcome the panelists here on the third panel. You can't fault me for being somewhat provincial to indicate that Mr. Ury is from my district, with Fusion Lighting, and I value his presence here as well as I value the presence of the rest of you, Mr. Fortin and Mr. Elkins.

I guess we were going through some questions here. I could just jump right in and ask you about your reaction to the bill that you've heard discussed. Maybe you've already talked about what your comments are about it, and whether you think that it should have any changes, or whether you think that in its present form, it would be very helpful for technology transfer.

Have you addressed that already?

Mr. FORTIN. We have not. I would only say that when we began our interaction with Sandia National Laboratories, these types of incentives were really unheard of for the laboratory scientists. When you set aside CRADAs, when you set aside contracts, and all the mechanisms that we use to interact with federal laboratories, really what it boils down to is people-to-people interaction.

We work just as hard as the Sandia scientists on our particular project. So there ought to be some type of incentive, or some type of reward for their hard work. In our particular case, it's successful commercialization.

So I wholeheartedly support the bill as amended.

Mrs. MORELLA. Excellent.

Mr. ELKINS. Unfortunately, I just received the amendments to the current law. Basically it sounds good.

My own experience with government labs are a mixed bag. And the more the laboratories recognize who they serve, and the more the incentives come from action and completion of tasks, the better off everyone will be.

And so in principle, I concur with what you're doing, and I intend to study the document, which I just received. And I'll write you a letter.

Mrs. MORELLA. Thank you. I appreciate that. Mr. Ury?

Mr. URY. To continue my remarks, we were talking about an arrangement with the Lawrence Berkeley Laboratory where they did invent an improvement to our original discovery. And we have signed a license agreement or option that turned into a final exclusive license agreement. And in actuality, we have now paid fees.

Future royalties have been established, and a development plan has been set with certain milestones that we intend to meet.

The message here is, LBL spent a fair amount of money, a year-plus, doing research in our area. They will get paid back in the future. I think both parties benefit. It shows. It's a good embodiment of your bill.

If I can make some comments on things that I would pay attention to if I were doing this over again, you do need an efficient process to reach closure on agreement. We never entered into a for-

mal CRADA that was in existence at the time within the DOE mechanisms, because it would have taken too long.

We did a cooperative research agreement, a modification of it, which we did rather rapidly. Speed to the marketplace is now a premium. It's the age of concurrent engineering. We must get to the marketplace quickly in a competitive world marketplace.

So my perspective on this is that you have to have an efficient process for these agreements. Two years, which I've heard is taking place, is too long. It should be much less than a year.

There needs to be controls on the dissemination of the research results. I'm not sure whether your bill addresses this. But when we do cooperative research, one of my fears is that publications before patents are applied for will leak the information to, [A] our competitors, who are outside the country.

Finally, many people have asked what a metric was. We're for success. I think it's the balance sheet of small companies like mine that are created with the help of cooperative research agreements, and the royalty stream that eventually will flow back to the national labs.

Somebody mentioned in the preceding panel, you have to be patient. If you're going to use royalties as a metric, it does take years, perhaps a decade before meaningful results are established. Thank you.

Mrs. MORELLA. With regard to the sulphur gas lights, from whom did you seek funding before DOE?

Mr. URY. As I said, we had spoken to several private concerns, competitive companies, very indirectly. We did go directly to EPRI, the Electric Power Research Institute, which represents a consortium of the public utilities which have a vested interest in more efficient lighting.

They for one reason or another turned us over, suggested that we talk to the Department of Energy.

Mrs. MORELLA. Do you have any idea of why? I was curious about the reasons.

Mr. URY. It was funding. We were looking for rapid funding to help to get this project moving. There was a real need within my company to show results in a short period of time.

I needed to get this program moving within less than a year, and I was turning over every stone. Finally, we met with the Department of Energy. And surprisingly, for a large government agency they moved extremely quickly, and the result has been a lot of remarkable progress.

We have recently won, along with DOE, the Discover magazine award for the environment for new technology, and IR&D 100 award. And if anybody cares to see this technology working, it's currently underneath the Forest Hall building lighting up the area over 10th Street, and the East Bay of the Air and Space Museum is lit up by these lamps.

Mrs. MORELLA. Yet it's interesting, the private sector couldn't come forward to fund you in that period of time.

Mr. URY. If I may add one thing. The private sector might have come forward, but we would have had to give up the company.

One of the problems with a small start-up company is, if you go out to the private sector too soon, they will help you. But they'll

take everything, including our incentive to continue the development, my incentive, particularly. Therefore, a small amount of help from the government goes a long way.

Since the government has printed its money, we've more than doubled it with investment from the private sector. It took this initial contact in 1992, and the seed money from the Department of Energy, to give the private sector confidence that this was a real discovery.

The result is, the money is now flowing in. We're going to need a lot of money to bring this to the marketplace, and I think it's going to come.

Mrs. MORELLA. Thank you. I want to ask Mr. Fortin, it's my understanding that the physicians at the University of New Mexico were investigating the possibility of using infrared light transmitted through human tissue to obtain information on blood chemistry without drawing blood.

How did you become aware of the technology at Sandia Labs involving nuclear weapons? How did the technology become available to you?

Mr. FORTIN. Our work really began as academic medical research in 1988. In fact, our corporate existence didn't begin until early 1993. So there was a fairly long period of time during which this was academic research for the sake of research.

It turns out that the limitations that the physicians at the medical school at the University of New Mexico had were in the area of data analysis. And really, through I guess a serendipitous occurrence, they were introduced to a group of chemists and mathematicians at Sandia who didn't really know much about biomedical applications, but were using techniques and tools in the analysis of nuclear weapons that could in fact be applied to a biomedical application.

That really happened through informal collaboration, and through contacts that the university had with Sandia. We're neighbors in Albuquerque, so it was quite easy.

Mrs. MORELLA. Rio Grande Medical Labs is involved in a CRADA with Sandia Labs. And I understand you're not receiving any financial assistance from the federal government. I'm curious about, is that correct, and why?

Mr. FORTIN. In fact it is correct for the glucose project, which is one of several projects we have under development. I believe the project had received funding through mid-1992 through the Department of Energy Technology Maturation Program. That funding was just cut off. The program dwindled down.

In our particular case, we had appealed to the Department of Energy to continue funding. And when it appeared that funding would be unavailable, we really had no choice but to go ahead and form a company, attempt to license the technology from the federal laboratory and from the university, and really plow ahead.

Our setup is somewhat unique. We're called 100 percent funds in CRADA, so we're not matched in any way by the federal government. So indeed that is correct.

Mrs. MORELLA. Before I turn it over to my colleagues, just a question. I don't want Mr. Elkins to feel that I have ignored him.

I understand that you have worked with both NASA and DOD labs?

Mr. ELKINS. Yes, I have.

Mrs. MORELLA. With regard to technology transfer, have you noticed a difference in attitude?

Mr. ELKINS. Very much so.

Mrs. MORELLA. Would you tell us?

Mr. ELKINS. My dealings with NASA started with the development of space suits during the Apollo project. And in that development, we created some technologies dealing with liquid cooling garments for the space suit.

NASA, naturally, moved that technology to the medical applications. Work I did with Ames Research Center, specifically dealt with breast cancer diagnosis using thermography, race car drivers cooling, multiple sclerosis, effects of both whole body and partitional cooling of MS patients, which have had dramatic results.

Cooling of children who are born without sweat glands, called HED, is the short name for the disease, and the use of micro-climate cooling for mine rescue teams, all were supported by NASA with small programs, and participation by the Bureau of Mines back in the early 1980s.

I found in trying to transfer this technology to military needs at both Army, Natick and Air Force, Brooks Air Force Base—met with less than affirmative response in spite of some very dramatic test results.

So the problem I had, or the criticism I would make of NASA at the time was that it was too little to really inject it into those marketplaces. Being a small company with limited resources, we could have used a more consistent support in the early stages.

In the last year, year and a half, because of dramatic results in the multiple sclerosis arena, there is a joint memorandum of understanding between NASA and the MS community to validate the technology. And validation on that graph from the previous group is something that's wanted and needed.

So that's ongoing now, and will be ongoing for the next year or so. That doesn't provide funds to my company. But it does provide the momentum and method for validation testing within the MS clinics.

Mrs. MORELLA. I want to thank you very much.

And I wanted to turn the questioning over to the ranking member of the Technology Subcommittee, Mr. Tanner.

Mr. TANNER. Thank you, Madam Chair. I won't be long. It's been a long day. I want to say how much we appreciate you all coming and waiting to testify here. This is extremely important, as I said earlier.

I am a believer in the concept of public/private partnerships. I think, given the vagrancies of the market, given the intense pressure from the markets, Wall Street and others on corporations and those that run them in this country, there is a real impediment to one's ability to engage in long-term research and development with no foreseeable return to the corporation.

It's just a fact of life in a laissez faire market-driven economy. And therefore, for that reason and others, I think that what we're

talking about here is extremely, critically important to the United States of America.

You all, I assume, heard my questions to the other two panels, because I think in the downsizing process we're undergoing here in Washington, we must come up with some way to measure cost, benefit, success, or failure, or whatever, of these programs. That's the only way I know we can carry the argument forward on the floor of both the House and Senate.

As we strive to make sense out of a concept that I think is absolutely critical to the future of this country, and so if any of you gentlemen have any thoughts in that regard that would help or be helpful in this instance, I'd sure be glad to hear it.

Mr. FORTIN. Two years ago, if you'd asked this question, I think we would have had a lot of charts indicating the number of CRADAs and licensees, and which state got how many. That's inconsequential from the perspective of a start-up company.

My survival depends on performance, and producing the products that I've contracted to produce. Ultimately, I think technology transfer will be deemed successful if endeavors like ours on this panel in fact produce those products.

Simply put, that's the most important thing from a perspective of business, and from this panel's, from your committee's perspective, I think it does take time.

Our particular technology has been under development for six years. We expect at least another three years of development at work. In an impatient Congress, that's probably inadequate, but I would suggest to you, that's the perspective of business.

Mr. URY. I would echo those thoughts, and just to reiterate what I said, the DOE, the national lab, was there for us when we needed them. I needed their expertise. I needed some funding to demonstrate a concept of a new lighting source. We lacked credibility before the world.

That's changed now. We're establishing our funding from venture capital sources. We've established credibility with some major demonstrations, and more to come. And I for one am very thankful for the system that exists now. It worked for us, and I hope it continues to work for many small companies.

Mr. ELKINS. I think it's important that the laboratories, at least my own experience, have to review what their mission is and who they serve. I think there's a tendency with time for what I call the Bridge on the River Kwai syndrome, where people forget why they're within the laboratory, about who they serve, are the users.

In the case of military laboratories, it's the people who go out and risk their life and limb for this country.

If the user or the person they serve is the laboratory itself, then they should no longer exist, or they need to reexamine and recreate themselves to fully serve who they were meant to serve in the beginning, when they were created.

And I think that isn't only a problem with government laboratories. I think it can occur in large organizations over time. There seems to be a metamorphosis that occurs, and it's something that somehow we have to reinvigorate these laboratories, or start them over.

Mr. TANNER. I know what you mean. I have a friend at home in Tennessee who was caught in a thunderstorm in a plane. He called down to the ground for some help, and didn't use the proper protocol in calling in. And the fellow said, "You'll have to call back and use the proper terminology." He said, "Look, I'm in trouble up here. Are you down there to keep me up here, or am I up here to keep you down there?" (Laughter.)

I think that's the same analogy that we've got. Do you have any recommendations along that line, either impediments to the process, or is the process itself, is there something we can do to help with the process, to make it more constructive in terms of what we want to see happen?

Mr. ELKINS. I think the term "sunset clause" comes to mind, that the laboratories need to be more entrepreneurial. They need to have projects and schedules just like industry does. And if they don't serve their customer within time and budget, they just don't exist any longer.

Mr. TANNER. One of the gentlemen on the panel before said that one way to measure success is by how many repeat customers that you have. I would just say again in closing, in thanking you for being here, those things that work, we need to hear about, and we need to build on them, because in this atmosphere, there is a feeling to cut and eliminate and withdraw from some of these programs, that I think are, as I've said before, worthwhile if done correctly.

Nobody's for waste, fraud, and abuse. But I just see a niche in the marketplace that can only be filled with some sort of investment by the people of this country in research that I quite frankly don't think would be done otherwise.

I would hate to see that happen, for our children's sake. Thank you.

Mrs. MORELLA. Thank you, Mr. Chairman.

The Chair recognizes Chairman Schiff.

Mr. SCHIFF. Thank you, Madam Chairman. I'll also be brief.

And thank you for your patience in waiting here to testify. It's been a lengthy hearing, but I think a very profitable hearing.

Also, just a reminder, since this is my last time to have time during this hearing, of the reception and demonstration in Room 2325 down the hall, when concluded here, which we invite again everyone to attend.

Gentlemen, I have one area I'd like to ask. And I think you've referred to it, but I'd like to ask it straight on.

One of the complaints about technology transfer is that government and private enterprise just don't work from the same points of reference. In fact, to be very plain about it, I've heard it said that it isn't just the leaders of the former Soviet Union who don't understand a market economy.

When you've been in a government program, "The check is in the mail"—every year, or every week, that you're not market-driven. And of course that world is changing, and I think the laboratories have understood that. But I'd like to know if you agree that they've understood it.

And what I mean is, do you find working with government laboratories that they are now, or are attempting to identify the pres-

sures on private enterprise? Or do you find very frankly that you're dealing with a government bureaucracy that is very rigid and difficult to deal with in terms of association with private enterprise?

I'll start, Mr. Fortin, with you, if I may.

Mr. FORTIN. Certainly. We found that once we had all of the contractual instruments in place, our relationship with Sandia has been quite swift and good, in terms of the pace of our work.

To give you some perspective, the original license to our technology from Sandia took about seven months to complete. After that, our CRADA process was about a five and a half month process. So, soup to nuts, we were about a year trying to get the infrastructure, if you will, of our company established.

With all of the legal wrangling behind us, it's been actually quite smooth sailing. I found our particular experience with Sandia to be, as I mentioned, quite good. They've been very responsive. It turns out that we work with the Sandia team in our facility outside of the fence, which I think really helps our day to day interaction.

We've tended to break down many of those barriers that I think we sometimes associate with a federal laboratory. To that extent, on a day to day basis, it's been exceptionally good.

Mr. SCHIFF. I just want to say, I was hoping you would say that. But I wanted to hear that from you who have the direct experience.

Mr. ELKINS. I have to say that in the case of NASA, who's always been cooperative in the area of technology application to the civilian sector and terrestrial applications, that they've become more proactive now in a sustained way in the MS community. I think that's laudatory.

The token contribution to technology transfer, however sincerely made, didn't get the job done. But I think the changes now are very positive.

On the other hand, I can't say that for Army Natick labs, in that they gave us a compulsory approval for use during Desert Storm of some adjuncts to a cooling system we supplied to explosive ordnance disposal teams. But it was limited to the use in the Middle East.

It is now five years since then, and we're still waiting for general approval. And that's business as usual. That's no change in what I saw in 1979–1980.

Mr. SCHIFF. That was with which labs you're talking about?

Mr. ELKINS. I mean Nadick Labs.

Mr. SCHIFF. Mr. Ury?

Mr. URY. I thought we were dealing with a national lab that was in transition. They clearly knew what the objective was in reaching out to the private sector. But they were gaining experience.

It wasn't a bad experience on my part. I didn't have that much experience on the other side of the table. But the negotiations went relatively quickly, and overall I was pleased, and they'll get better at it as time proceeds.

Mr. SCHIFF. Thank you.

I yield back, Madam Chairman.

Mrs. MORELLA. Thank you, Chairman Schiff.

I wanted to now recognize Mrs. Lofgren.

Ms. LOFGREN. Thank you, Madam Chairwoman.

First, although Mountain View isn't in the 16th Congressional District, it's pretty darn close. I would especially like to welcome Mr. Elkins here, and suggest something I've thought about doing often in the past six months, which is that, in the future, Madam Chairwoman, I would like to request that we consider having the people from private industry testify first, so they don't have to wait till the end of the day.

I know that the pattern is completely different in every committee in the Congress, and maybe——

Mrs. MORELLA. We will certainly consider that.

Ms. LOFGREN. I think it would be a nice gesture, and to thank you all for caring enough about our country to be here and testify.

I'm interested in the summaries. And it looks like there's a lot positive. But there are some needs-to-improve areas, as well.

Mr. Elkins, I was particularly interested in your judgment. Do you think you could have done what you had done without the involvement of the federal government, bulky as it was? Was there something out in the private sector that would have allowed you to succeed in your efforts without the role of the federal government?

Mr. ELKINS. No, I really don't. I've never had a CRADA. I never had an SBIR. But the activities I participated in during the golden days of NASA when the space program to get a man to the moon was happening has led to a number of technologies that wouldn't have existed without that high tech participation.

So the answer is no, I don't think we would have gotten there. I'm indebted to the government, and to the national goal of getting us to the moon. I don't think people really recognize how much that's meant to the country.

Ms. LOFGREN. I don't want to put words in your mouth. But if I'm hearing you correctly, you think we can improve the interface, but you're not opposed to the investment, and you see the value of the federal investment?

Mr. ELKINS. I think it would have been a lot more valuable if it were easy to transfer technology from NASA through a small company into other government labs. It's like the not-invented-here sign goes up, and that was unfortunate. And hopefully in these times of downsizing and looking at budgets, we can get back to the entrepreneurial spirit that was so dramatic during the Apollo program. It was a joy to work with the people on that program, on both sides of the fence.

Ms. LOFGREN. I sense from your testimony that the interface with NASA was certainly more suitable than the interface with the military labs, or it was smoother and worked more easily.

Given the director, Mr. Goldin's plans for NASA and increased networking with the private sector, I wonder if you'd have just two or three suggestions for labs other than NASA, sort of picking up on what NASA did well that we can incorporate in other labs that would make this whole technology transfer situation work better.

Mr. ELKINS. I think that the first rule I would say is, review your mission and who you serve. I think the aviation simile that was given by Mr. Tanner is certainly there in some of the older, more mature labs. I think in all cases that, if there is a desire to transfer

technology from whatever department, NASA or DOD, that has to be done on a sustained basis.

A short-term investment to transfer technology, for instance in the MS community, would not work. It takes a sustained plan to get it done. And I think there should be sunset clauses on any project in any laboratory. And I think there should be rewards.

I don't think security is the kind of reward we want in R&D laboratories. I think there needs to be a reward for getting the job done, incentives for getting the job done. And I don't know what those are exactly—remuneration for that, royalties, whatever. But some means of rewards for getting the job done, and no rewards for not getting the job done.

And I think in some laboratories, the inverse is true.

Ms. LOFGREN. Madam Chairman, given the hour, I will return the balance of my time to you.

Mrs. MORELLA. Thank you, Ms. Lofgren. As a matter of fact, if you'd like to offer any questions, and there may be some members who would like to submit in writing questions to you for your responses.

Ms. LOFGREN. Thank you very much.

[The prepared statements of Mr. Fortin, Mr. Elkins and Mr. Vry follows:]

DRAFT OF TESTIMONY TO HOUSE SUBCOMMITTEES ON BASIC RESEARCH AND TECHNOLOGY

Tom Fortin, Rio Grande Medical Technologies, Inc.

Introduction:

It is a pleasure and an honor for me to be here today to discuss our experience with federal technology transfer, and specifically to describe to you how technology transfer can be successful in helping to solve "real world" problems. I represent a small New Mexico company named Rio Grande Medical Technologies that is involved in collaborative medical research with Sandia National Laboratories in Albuquerque. Together with scientists at Sandia, we are developing a novel medical technology that holds great promise in helping diabetics more easily manage their disease state. This medical technology is an outgrowth of nuclear weapons research that has been underway at Sandia for many years.

My goal today is to describe this medical technology and to emphasize the importance of collaboration with Sandia to our work. I would be delighted to answer any questions during or after this brief talk.

The Context and Cost of Diabetes In America:

In order to describe the potential impact of our medical research, it is important to understand the context of the diabetic disease state. At present, there are roughly 15 million diabetics in America of which only 50%, or 7 million people, have been properly screened and diagnosed. Those who are undiagnosed may be at severe risk of dangerous secondary complications. Of the approximately 7 million diagnosed diabetics, some 2.5 million people regularly test their blood sugar 1 to 5 times per day using an invasive technique known as a finger stick.

Diabetes is a costly disease to the individual diabetic and to the American health care system. Diabetes is the leading cause of blindness among Americans, is the largest single cause of limb amputation and it may lead to kidney failure. The American Diabetes Association has stated that the cost to our society of treatment of these secondary complications exceeds $10 billion per year, most of which is paid for through Medicare and private insurance.

Clearly, a medical and societal goal should be the early detection and treatment of diabetes in order to prevent onset of severe secondary complications. This goal can be achieved through regular monitoring and tight control of blood sugar.

Present Measurements Inadequate, Non-invasive Measures Optimal:

The invasive finger stick method of blood sugar testing is painful, costly, and potentially dangerous to patients. Diabetics often develop thick calluses on their fingers that limit the amount of blood they can draw for testing. The invasive technique also creates a bio-hazard disposable and in this day and age of blood borne pathogens, one would prefer to not draw blood if possible. In addition, the average diabetic spends approximately $1,500 per year on test strips alone to manage their blood sugar level.

Though invasive blood sugar testing helps many diabetics, a non-invasive technique that does not require invasion of the skin to obtain a blood sample would be far preferable to present testing devices. If the non-invasive test could make regular testing painless and simple, it follows that diabetics would test more regularly, thereby keeping tighter control over their blood sugar. This tighter control of blood sugar could help decrease the secondary complications from diabetes and potentially lower the overall cost of the disease. Ideally, we would like to identify and help the 7 million diabetics who are presently *undiagnosed* and who do not test their blood sugar at all.

Sandia Technology Enabled Medical Breakthrough:

Our collaborative team in New Mexico has made much progress toward the realization of a device for non-invasive glucose monitoring, and, in large part, we can thank the federal technology transfer process for making this happen. Our research began in 1988 as an informal research project between physicians at the University of New Mexico School of Medicine and scientists at Sandia National Laboratories. Our technology is based on near infrared spectroscopy, a detection technique that uses infrared light to detect and measure unknown chemical substances. Though well known to industrial chemists and scientists, spectroscopy has found only limited utility in bio-medical applications due to the complexity of human blood and tissue and the difficulty of sampling and measuring blood glucose.

Early in our work, physicians at the University of New Mexico believed that infrared light transmitted through human tissue could provide valuable information about blood chemistry without the need to draw blood. However, due to the complexity of blood and the very small amount of glucose in human blood, the physicians were limited in their ability to interpret their data. We were fortunate to realize that world class expertise in interpreting this type of data was available at Sandia National Laboratories, located in Albuquerque, New Mexico. The Sandia scientists we work with had no experience in bio-medical applications, but had many years of experience using spectroscopy to analyze the aging of stock-piled nuclear weapons. In analyzing the stock pile, they were using spectroscopic techniques to assess the evaporation of gases from those weapons.

From Nuclear Weapons To Medical Devices:

Though it took quite a leap of faith to go from analyzing nuclear warheads to testing human blood sugar, in fact, the connection was made and our research made extraordinary advances thanks to the expertise of Sandia scientists. In the first three years of research, a series of patents and scientific articles were completed.

Based on this progress, it became quite clear that a large opportunity existed to commercialize the technology and bring to the marketplace a much needed and innovative medical device. Therefore, in early 1993, Rio Grande Medical Technologies was formed to serve as the manager of this commercialization effort.

Today, we are regularly testing with high precision many diabetics from all walks of life on a research-grade machine that is both bulky and costly. We still have a number of technical hurdles

to overcome in terms of miniaturizing the device and making it more robust and accurate, yet we believe we are well positioned in terms of technical and financial resources to do so.

The Value of Technology Transfer and Collaboration:

Continued collaboration with Sandia scientists is absolutely essential to technology transfer in general and is crucial to our work in monitoring blood glucose. Without the ongoing, daily interaction among our own engineers, physicians from the University and scientists from Sandia National Laboratories, we would be unable to move this project forward. We work with the Sandia team through a Cooperative Research and Development Agreement (CRADA) that defines our working relationship, but I can assure you that our daily interactions with the people from Sandia transcend this legal document. We have brought together investigators from three very different institutions and cultures under one roof working toward a common goal. This proximity and contact among investigators is absolutely crucial to our continued progress toward our goals, and it has spawned many exciting and spontaneous developments.

As a company, we pay 100% of the costs of this CRADA involvement and do not rely on federal funding to match any portion of our glucose research. In this respect, our collaboration is quite unique; most federal technology transfer activities entail some form of government matching to augment industry funds. We are fortunate to have the resources to pay for this arrangement.

By definition, federal technology transfer projects must display important commercial potential and must also add to the core competencies and central missions of the federal laboratories. Because industry typically funds a portion of this collaborative research, federal dollars are also leveraged toward satisfying the missions of the various federal labs. By teaming, federal laboratories and industry can more readily and rapidly tackle substantial technical problems in a unified manner.

Conclusion: Solving Real World problems Through Collaboration:

When you look at the history of our efforts to bring the glucose device to reality, it is clear that solving complex problems of this nature requires substantial time, financial backing and scientific resources. We feel that our interactions with Sandia National Laboratories and the transfer of technology from the lab to a commercial entity has been an absolutely critical step toward realizing our objectives. Without the tech transfer link to the labs, we could not have made this much progress, and we would not have the possibility of introducing novel technologies that will help to solve a major medical problem for our nation.

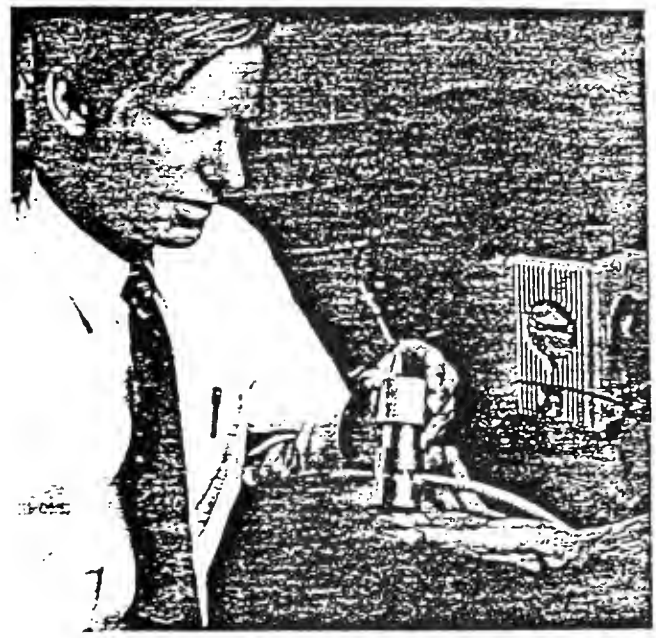
In summary, this committee will help to decide the future of technology transfer programs and funding for our federal laboratories. Our small collaboration has shown that federal technology transfer can indeed make contributions toward solving real world problems. I urge you to carefully consider the value that technology transfer from federal laboratories brings to our nation and the importance of this process to solving significant technical problems for the benefit of all Americans.

Thank you for providing me the opportunity to address the committee. I welcome any questions or comments that you may have.

SANDIA, ACADEMIA, INDUSTRY WORK TO TAKE PAIN OUT OF DIABETICS' FREQUENT BLOODSUGAR TESTS

INFRARED SENSOR MONITORS GLUCOSE LEVELS, SHOWS POTENTIAL FOR CHOLESTEROL AND ALCOHOL SCREENING

A chemometric monitoring tool, developed to measure low-volume gases in aging explosives, is being adapted by University of New Mexico biomedical researchers and Sandia scientists to measure blood-glucose levels in humans. Painless, fast, and much more informative than the "snapshot" provided by a blood test, the noninvasive glucose monitor will make life a little easier—and a lot safer—for diabetics.



Δ Dr. Ries Robinson assists a patient as he inserts his finger into a prototype of the Noninvasive Glucose Monitor, a collaboration between Sandia and the University of New Mexico School of Medicine. This monitor uses near-infrared light to detect concentrations of glucose.

Applying tenets of biology, spectroscopy, and statistical analysis, a research team including industry, Sandia chemists, and University of New Mexico medical-school residents is finding new work for military technology in hospitals, doctors' offices, nursing facilities, and even at home. A dramatic example of technology transfer, the Noninvasive Glucose Monitor could touch the lives of approximately 2.5 million Americans—those afflicted with diabetes. Instead of submitting to a needle, a diabetic will expose a finger, painlessly, to near-infrared light.

A main concern in the treatment of diabetes is ensuring that patients test themselves frequently enough, in many cases four or five times a day. Obviously, taking blood samples this often is inconvenient, expensive, and painful, and the pain only increases as patients begin to develop calluses on their fingertips. Further, a blood sample provides just a "snapshot" of the patient's glucose level at one point in time; critical situations such as surgery and childbirth require multiple samples.

The information provided by these tests, however, is vital to the prevention of diabetes' many dangers: kidney disease; amputations; and increased risk of heart disease, strokes, and blindness. An average of 12,000 Americans lose their sight annually from diabetes. An estimated $20 billion is spent each year on the care and treatment of diabetes and its potentially fatal complications—complications that

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THE PAINSTAKING TECHNOLOGY BEHIND THE PAINLESS GLUCOSE MONITOR

As complex as a "near-infrared spectroscopic monitor and chemometric data analysis tool" might sound, the principle behind the Noninvasive Glucose Monitor can be expressed fairly simply. The monitor portion of the technology centers on the fact that every natural substance absorbs light at specific wavelengths. The direct application, then, is to expose a substance to light and identify it based on the wavelengths it absorbs.

Chemometrics, the other half of the glucose-monitor equation, is a relatively new branch of analytical chemistry. It uses a mixture of mathematical and statistical

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could be prevented with closer monitoring.

Now, technology developed at Sandia National Laboratories is being adapted to address these and other problems associated with diabetes care in specific, and blood characterization in general.

Combining Interests, Expertise

The development of a new glucose-measurement tool was initiated in 1989 by Ries Robinson, MD, then a medical student already degreed in mechanical engineering. Robinson, inspired by a summer job with a biomedical engineering company, discussed with Dr. Philip Eaton his interest in noninvasive methods of measuring blood elements. Eaton, director of UNM's General Clinical Research Center and Chief of Endocrinology at the School of Medicine, had worked with researchers from Sandia in the 1970s on an implantable insulin pump and recommended that Robinson contact the Labs.

When he did, he met with considerable interest. For nearly 16 years, Sandia National Labs has helped pioneer the use of chemometrics, a combination of mathematical and statistical tools, to analyze spectral data. Chemometric data analysis was developed at Sandia to monitor the low concentrations of gases that evolve during the aging of explosive materials. On hearing Robinson's idea for a noninvasive glucose sensor, Sandia chemist David Haaland and his supervisor, Jim Borders, thought Sandia's resources might fit the bill.

Robinson spent the next two years as a volunteer at the University and Sandia to help develop the technology. Then in 1991, he began a unique residency under which he both conducted research and biomedical engineering at Sandia and performed clinical duties at the School of Medicine.

Managing the Transfer

When Robinson's concept was ready to implement, he launched another innovative effort, this time to establish a private company that would produce a commercial version of the sensor. This effort resulted in the forming of Rio Grande Medical Technologies, Inc., or RGMT. UNM's Eaton, who became well-acquainted with the technology transfer process during his work on the implantable pump with Sandia, explains why this arrangement is so important to Sandia, UNM's School of Medicine, and the evolution of the technology itself.

"One traditional mechanism for technology transfer...is simply to license the information and never hear about it again," Eaton says. This approach is fine in the business arena, but for an educator, information loses value once it's been licensed, he says. An on-campus lab typically would be dismantled following licensure, he explains, preventing the licensed technology from becoming the basis of further study.

Departing from this tradition, RGMT leases lab space on the School of Medicine's campus, which benefits biomedical engineering students, residents, and faculty. "We couldn't duplicate the resources here anywhere else. We have the possibility of doing some remarkable research," Robinson says. Considering that combined training in medicine and engineering is expected to become more important as medicine becomes more technology-driven, UNM students and faculty definitely appreciate the lab's presence on campus. RGMT also contributes to the salaries of the UNM and Sandia researchers based on the time each devotes to the project.

Defining "Success"

Of the possible applications, the most celebrated both in the media and by diabetics is a cost-effective home monitor, ultimately in a portable version that could be coupled with a programmable, implantable insulin pump. The pump would be based on Eaton's earlier work with Sandia, a version of which is currently being tested in several hundred patients worldwide. Also under development in the RGMT-funded lab are adaptations to measure other blood elements, such as alcohol and cholesterol.

At this time, the glucose monitor still exists in developmental form only, but has been proven in tests to approach the accuracy required for use by diabetics. Although there's nothing ready to "take home" just yet, Sandia's Haaland calls RGMT's formation a success story in itself. "We have successfully used Sandia technology in collaboration with a university, and that has resulted in the founding of a small business in Albuquerque, thereby bringing a lot of research money into New Mexico. And, the technology has potential to produce a commercial product. That's the success at this point."

Borders agrees. "The interaction between our group at Sandia and the group at the UNM medical school has resulted in the capability to create an output that neither of us could have done individually." —CB

PAINSTAKING (CONTINUED)

tools that allow chemists to analyze vast quantities of data and extract useful information to a degree that was previously impossible.

The glucose monitor incorporates this groundbreaking tool to analyze the spectral data from a reading and provides medical professionals with an abundance of information on the composition of a patient's blood—as either a snapshot of one point in time, or, if necessary, as a monitor of activity over time. Continuous monitoring, which provides rate-of-change and direction-of-change information, is more informative. Further, information on fluctuations could be of tremendous help in prevention and treatment research efforts.

A typical reading would proceed something like this.

1. The patient inserts a finger into a cylindrical device.
2. The device transmits near-infrared light through the patient's finger.
3. The light, after passing through the finger, is dispersed into a spectrum.
4. The device then analyzes the spectral data for glucose-specific light absorption, which indicates a concentration of glucose.

The analysis algorithm is designed to correct for differences in pigmentation, blood chemistry, and finger thickness, which can affect the initial reading.

Hearing on Technology Transfer and Government Laboratories
by the
U.S. House of Representatives
Committees on Science & Basic Research
June 27, 1995
Written Testimony of
William Elkins, Chairman & Director of Product Development
Life Enhancement Technologies LLC

I. **Introduction:** I have been involved in Research and Development both within government laboratories and in Industry since 1958 and have gained a perspective on what works and doesn't work in the areas of interagency transfer, transfer of industry technology to government laboratories and transfer of government technology to private industry.

A. To lend some credence to my perspectives, my technical contributions follow:

- 1958-59: Air Force Fighter Pilot and R&D Officer:
  a) Developed and was the first subject to test a space restraint system (patented) to 16.5 G over a three minute profile. This test remains a benchmark for extended human G tolerance.
  b) The technology transfer to Aerospace led to a series of aircraft and helicopter seating products.
- 1963-65: Space Suit Lead Engineer, Litton Space Systems
  a) Developed the first rigid structured suits aimed at space applications.
  b) Developed the Lunar Receiving Laboratory Glove/Arms which operated at one atmosphere overpressure. This technology saved the government several millions in the design and construction of a simplified Lunar Receiving Lab. The high pressure operating capability the Glove/Arms eliminated the need for low pressure (3.5 Psia) antechamber and shortened operator work periods
- 1966-1969: Chief Engineer, Advanced Space Suits, AiResearch
  a) Developed a series of highly mobile high pressure space suits designed for the Extended Apollo Missions.
    (1) Patents on sealed bearings, space suit joints.
- 1970-1980: Manager, Life Support System Dept., Acurex Corp.
  a) Developed a series of partitional personal cooling systems (patented) for NASA which were further developments from Space Suit life support technologies.
  b) Proposed an armored vehicle crew cooling system based on our commercial (NASA technology transfer).

- 1980-1994: Chairman and Chief Engineer, Life Support Systems, Inc.
  a) Microclimate cooling products for Military, Industrial and Medical applications.
    (1) 1982: USAF project. Developed and Flew the first microclimate system for fighter aircraft.
      (a) Created a backpack cooling system for chemical defense activities. Tested with outstanding results. (See attached graph)
    (2) 1988: Demonstrated breakthrough therapy of MS patients by microclimate (head vest) cooling. Resulted in induction into the US Space Foundation's Hall of Fame in 1993.
    (3) 1988: Demonstrated feasibility of treating superficial cancers using liquid heated thoracic garment.
- 1991-92: Participated in Operations Desert Storm by upgrading existing cooling systems used by Army, Navy EOD teams.
  a) Received the Commander's Award For Public Service for contributing to the success of the operation.
- 1991: Our cooling system used by Army EOD team in the Solomon Islands during removal of 109 WWII mustard gas shells. Reduced duration of task 20 fold (8 hours instead of 5-6 weeks). See testimonial letter.
- General: our technology has been used in the following medical applications:
  a) Hair retention during chemotherapy
  b) Breast Cancer thermography
  c) Multiple Sclerosis
  d) Cerebral Palsy
  e) Surgical Arena Norma Thermia
  f) Cancer whole body hyperthermia
  g) In development: Cardiac Arrest brain hypothermia
  h) Post orthopedic surgery therapy
  i) Cooling for children with Hypohydrotic Epidermal Displasia (HED) and other children's genetic disorders.

II. **General Statement:** NASA has recently taken a pro-active role in technology transfer to the medical sector. Specifically, in 1994 Dan Goldin, the Administrator signed a Memorandum of Understanding with the MSAA (Multiple Sclerosis Association of America) to support a program which will validate the use of partitional cooling in the improvement in the quality of life for those with MS.

A. I applaud this activity. In 1977 NASA and I demonstrated the benefits of liquid cooling garments in the physical therapy of MS patients at UCLA Rehabilitation Center. Because, at that time, no formal, pro-active mandate existed and the small limited resources company I worked for could not independently support the commercialization of the technology progress was very slow to the detriment of the MS community and the company which had transferred the technology.

B. In sharp contrast to the continuing cooperative tech transfer position of NASA, my experience with the Air Force Aerospace Medicine Laboratories at Brooks AFB, and even more markedly my experience with the Army's Natick Laboratories are very depressing and frustrating.

1. In 1979 we proposed to the Army's Advanced Concept Team (ACT) a means of cooling tank crews. The proposal was received favorably at the Pentagon and we were invited to present the concept at Natick Laboratories. Because I was so shocked by the response of the civil servant at Natick, I can still quote the person verbatum.

   a) His response to our proposal was, "Gee, we know that will work, why should we do it? Can't you come up with something more exotic that might take twelve years to develop?"

   b) That was nearly twenty years ago. During Desert Storm there were two microclimate systems in operational use. Our system for the Explosive Ordnance Disposition teams and the Natick air vest in use with the Abrams M1A1 tank and the with Air Force Rapid Runway teams.

      (1) The air vest was found to be unacceptable in the Abrams Tank and, in my estimation, would have been extremely hazardous for use in the Air Force application.

      (2) I have enclosed three documents covering armored crew response to our system at the National Training Center and an EOD extremely hazardous operation in the Solomon Islands.

         (a) Although Natick Labs were forced to accept the use of our systems in Operation Desert Storm, they have yet to approve the use of a key piece of equipment, the Pass Through Connector (PTC) for general us by Army EOD teams. (The PTC was used very successfully in the Solomon Islands operations without Natick's authorization.)

            i) By the way, the Japanese Southwest Asia Peace Fund purchased nearly 400 of our cooling systems for the US Army. These systems worth well over a million dollars remain in storage because of

Natick's glacial speed in approving the use of the PTC.

2. In 1982 our microclimate cooling technology which had its origin in the work we did for NASA met with considerable success in field evaluations for Air Force Chemical Operations. Both ground crews performing hot weather Rapid Runway Repair in Chemical Defense gear and Fighter Crews flying in F-4 Aircraft found that they could operate with near normal efficiencies while their operations were severely hampered without our cooling systems.

   a) Dr. Terrian, the ground crew test conductor comments follow:

      (1) "----- it may be concluded that the auxiliary cooling provided by the water cooling system used in this study had eliminated the thermal burden imposed by the CD overgarments, e.g., overjacket and overpants. Our data for Heart Rate and Sweat Rate support this conclusion. Thus all three of the physiological indicators we used to monitor heat stress in this field study strongly suggest that the military effectiveness of well-trained men, who must perform strenuous work (Rapid Runway Repair exercise) in a full Chemical Defense posture, can be greatly enhanced by the provision of commercially available portable cooling systems."

3. Funds were made available to accelerate operational evaluations. At the kick-off meeting for the next phase, I was told by a civil servant, "Don't worry about it Bill, your going to fail."

   a) And fail we did. The test which "proved" we were unacceptable for aircrew use, I still use to show how effective we are. I even took the results to the Air Force Surgeon General who agreed that the results were acceptable.

III. **Conclusion:** I have come to the conclusion that there exists within mature research organizations a change in the perceived purpose of the organization. In the beginning the goals are the serving of the user. People are risk takers and want to get the job done.

However, over time the goal of the research organization becomes the perpetuation of the organization itself. Thus the statement, "Gee we know that will work, why should we do it?" was made without any twinge of conscience.

In my younger days as an Air Force R&D Officer, I had a commanding officer, Colonel Pete Taylor, who told me that all R&D organizations and facilities should be bulldozed every 20 years. It has taken me a long time to realize how right he was.

IV. **Recommendation:** Technology transfer has a number of paths:

- **Government Agency to Government Agency**: Most of my efforts in dealing with the military R&D laboratories has been involved in the transfer of technologies developed for NASA.

  We have met with limited success by working around the R&D laboratories and going directly to the operators. There is absolutely no correlation between the government R&D laboratory findings and the results with the users and independent laboratory tests.

- **Commercially Developed Technology to Military Use:** See above.

- **Government Agency to Commercial Applications:** Until the change in NASA's mode of operation, there was insufficient support of technology transfer to make the odds of successful transfer very low indeed.

- I believe all Government Laboratories must have incentives to get the job done. Rewards should be made for success and not perpetual running in place. If a job is not done on an accelerated but realistic schedule, then it should be terminated. Personnel who make a difference should receive rewards for a job well done.

  Those who find ways for technology twice used should be doubly rewarded. Today the inverse is true. The more the job can be subdivided the greater the opportunity to grow the organization, be promoted and retire without having made a difference.

MSG Joseph A. Santoro
Detachment NCOIC
6th Ord. Det. (EOD)
Schofield Barracks, HI 96857

28 October, 1991

Mr. William Elkins
Life Support Systems, Inc.
1400 N. Shoreline Blvd.
Mountain View, CA 94043

Dear Bill:

Just wanted to take a few minutes to let you know how much the personnel of the 6th EOD appreciate the LSSI Cooling Suit and its capabilities. This is an excellent piece of equipment and does all that your company says it will do.

SFC Madsen, SSG Toben, SSG Johnson, PFC Corona and myself all feel that without your equipment it would have been impossible for us to have completed the Solomon Islands mission. It took us a total of 8 hours downrange to package the 109 HD (Mustard Gas) filled rounds.

Without the suit we feel it would have taken us as much as 5 or 6 weeks to accomplish the same task.

I will be more than happy to recommend your suit to anyone who has to work in high temperature conditions and remain free of contamination. Feel free to use my name at any time should any of your future customers want a recommendation.

Again, "Thank you for the fine piece of equipment that your company has produced. Please thank your employees for a job well done".

JOSEPH A. SANTORO
MSG, USA

DEPARTMENT OF THE ARMY
HEADQUARTERS, 1st BATTALION (MECHANIZED), 52 INFANTRY
FORT IRWIN, CALIFORNIA 92310-5000

REPLY TO
ATTENTION OF

AFZJ-ABI-O

17 OCT 91

MEMORANDUM FOR: Record

SUBJECT: Life Support Systems' Crew Cooling System

1. Ref. MFR, 21 Aug 91, Subject AAR Life Support Systems, Inc. Cooling Vest initial trial.

2. During Rotation 91-12, 08-21 SEP a second test of the proposed crew cooling system designed by Life Support Systems, Inc. was conducted by 1-52 Infantry. The test consisted of installing two improved breadboards, driver and turret (See referenced MFR for description), into a BMP for the length of the rotation. The BMP chosen was A Company's 111. The crew participated in all rotational missions.

3. Mechanically, both systems performed flawlessly. Comments from the crew suggest that it improved their ability to man and fight their vehicle due to the elimination of heat stress.

4. The physical arrangement of the turret system still continues to cause some problems. In the first prototype, the coolers and pump were placed on a mount that was secured beside the main gun. All vest cooling lines ran from the pump. This setup used a large amount of space and the multiple lines presented opportunities for fowling.

5. The second model made use of the ammunition stowage rack in the BMP to secure the coolers and pump unit. Further, the number of coolant lines was reduced by using a common trunk from which the individual lines branched. These improvements reduced the space used by the system a great deal. However, a suggestion made by the crew which will be implemented in the third prototype will cut special requirements to a minimum. The idea is to fabricate a modular base that will contain the pump unit and allow one cooler to be secured onto it. The base/cooler module will then be able to be fitted to the second base/cooler module in a variety of combinations, side by side, front to back or stacked. This will allow each crew to optimize the system placement to their own tastes.

6. Logistical support of the system (ie ice usage) was a concern at the outset of testing. The cooling unit used much less ice than anticipated. In fact, once filled, the coolers only needed to be topped off with ice every other day. A final testing of the system using two platoons, one equipped as a control, would establish a good baseline for ice use.

7. Overall, the system's ability and function was impressive. It is suggested, though, that a final platoon level test be conducted. This is needed to determine logistical requirements and parts failure rates under actual use.

6. POC this office is CPT Hoffman, Assistant S-3, ext 4029

THOMAS M. HAGEN
MAJ. IN
Battalion Operations Officer

DEPARTMENT OF THE ARMY
HEADQUARTERS, 1st BATTALION (MECHANIZED), 52 INFANTRY
FORT IRWIN, CALIFORNIA 92310-5000

REPLY TO
ATTENTION OF
AFZJ-ABI-0

21 AUG 91

MEMORANDUM FOR: Record

SUBJECT: AAR, Life Support Systems' Cooling Vest

1. On 29-30 July 1991, representatives of Life Support Systems Inc. presented a prototype personal cooling system for use in the M-551. The system presented consisted of two units: one for the turret crew and one for the driver. Each unit was composed of two GOTT coolers (5 gallon in the turret, 2 gallon in the driver's compartment), a multivoltage recirculating pump, attachment umbilical, and a personal vest and head-piece for each crewman. The system cools the body's core by passing chilled water (39-48° F) through the vest and head-piece which are worn over the BDU T-shirt and under the CVC helmet. No contact is made between the user and the cooling water, it is a closed system.

2. The cooling system water* is moved from the vest to the heat exchangers. Here, the system water releases heat to the ice in the GOTT coolers and is rechilled, melting the ice and producing drinking water. The chilled water passes through the recirculating pump and then to a mixing unit that controls the vest and head-piece temperature by mixing the incoming chilled water with out-going warmed water.

3. The cooling effect achieved by the systems was not measured empirically during this test. The participants, however, agreed that the effect was quite significant. Two test runs were made, a four hour, and an eight hour. Temperatures inside of the vehicle varied from 98° to 110° F. The temperatures perceived by the vehicle occupants was from 72° to 80° F. Water consumption was considerably lower than average: 16 ounces per person on the 8 hour trial.

4. No restriction of movement or interference with vehicle control was observed by the vehicle occupants. During these preliminary tests, no turret rotation was involved.

5. In summary, the cooling system is compact, easy to use, should require minimum maintenance, consists of easy to obtain parts- excluding the recirculating pump and cooling vests, and performs remarkably. As a system designed to reduce crew discomfort and fatigue, it seems well suited. Further studies of this system should focus on: replacement parts costs, repair times (simulated and real), interference with vehicle use, ice usage, and availability, and crew reacclimatization to ambient conditions.

6. POC this office is CPT Hoffman, Assistant S-3, ext 4029

THOMAS M. HAGEN
MAJ, IN
Battalion Operations Officer

* (The circulating liquid is a mixture of propylene glycol, water and other additives. Its circuit is completely sealed and separated from the potable ice/water supply by a copper heat exchanger.-ed.)

SUBJECT: AUGUST '89 EVALUATION OF LSSI MICROCLIMATE COOLING SUIT CONDUCTED AT MCB TWENTY NINE PALM, CA,

1. Received authorization to conduct evaluation of LSSI Head/Vest Microclimate cooling suit in OV-10 and UH-1 aircraft. Because of ejection seat compatibility questions, did not receive authorization to fly system in 0V-10.

2. 0V-10 pilot wore LSSI suit along with MA-2 Torso Harness (380 MOD) G-SUIT, Flight suit and form fit helmet. No fit or comfort problems were experienced by pilot.

3. Pilot manned up, closed cockpit and taxied aircraft to run up area. Ramp temperatures at this time were 101° F (38.3° C).. Cockpit temperatures exceeded 120° F (49° C) during 20 minute static and taxi test. The pilot stated he felt cool and comfortable with no noticeable sweating, a normal and annoying occurrence during hot weather OPS.

4. The same positive results were reported by a UH-1N pilot who wore the cooling suit for 15 minutes in a Huey parked on the EAF ramp.

5. My own experience with the system paralleled those of the other two evaluations.

6. As an observer in the back of a UH-1N, I flew on a three hour Turf Flight (both high and low bird). During the flight we experienced outside air temperatures between 110-115° F (43°-46°C).

7. Several times during the flight I actually turned the system down to determine just how hot it was. And it was hot! With the system turned down dampness/perspiration was noted. (Rheostat needs wider range for better climate control.

8. The 6 foot umbilical cord did not present a problem moving around the rear of the aircraft cabin.

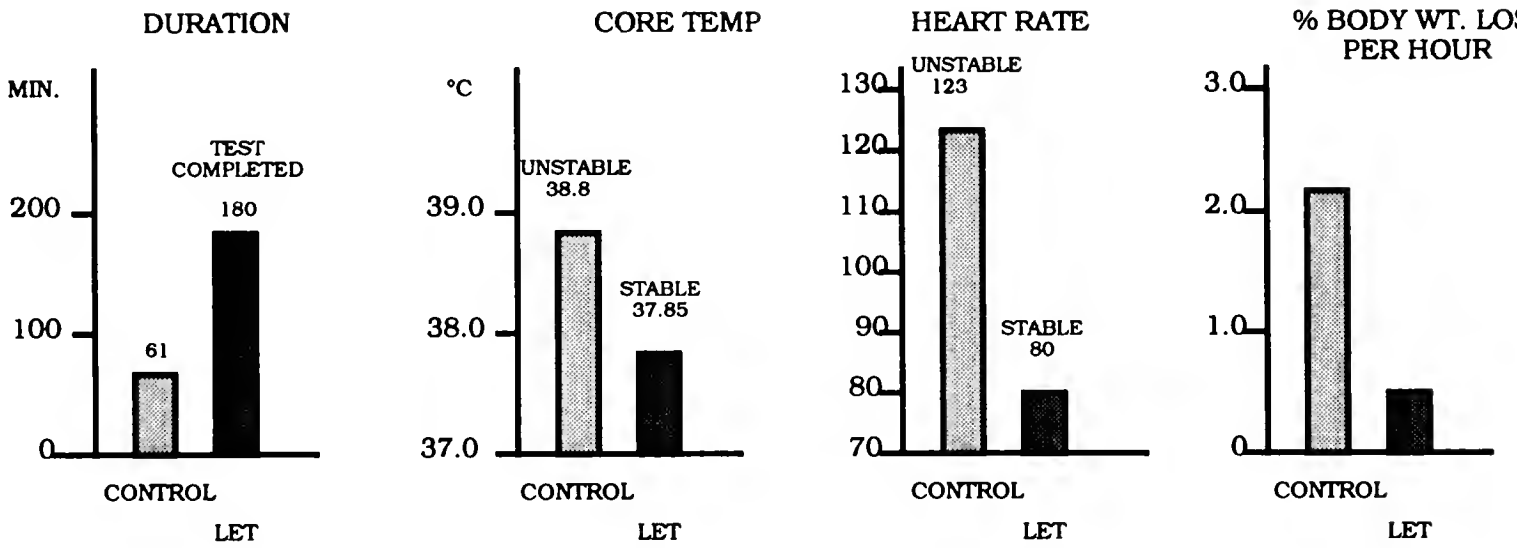
9. The cooling cartridges (which had been kept in a picnic cooler the entire day prior to the flight at 1300-1600) lasted over one hour before a decrease in their effectiveness was noted. At 1.5 hours the cartridges no longer were providing cooling and were changed out during the first fuel stop. The cartridges put into the heat transfer unit had not been refrigerated or cooled during the previous 1.5 hours. They had been kept in a helmet bag in the aircraft.

10. The replacement cooling cartridges provided adequate cooling for approximately 45 minutes with noticeable cooling effect drop off for the remainder of the flight. However, some cooling was provided as determined by turning the system on and off.

11. Battery power was more than adequate for the entire flight.

12. After a 12 (plus) hour day, which included a 2.5 hour drive out to 29 palms, 8 (plus) hours at 29 Palms (including flight) and 2.5 hour drive back to Camp Pendleton, the most significant effect noted was the <u>lack of fatigue</u> normally associated with a long day, hot weather and a demanding three hour flight. In my opinion, the head-vest cooling suit is an inexpensive human performance enhancer and force multiplier.

FLIGHT CREW
WEARING CHEMICAL DEFENSE
ENSEMBLES
AIR FORCE TESTS CONDUCTED
IN 1983

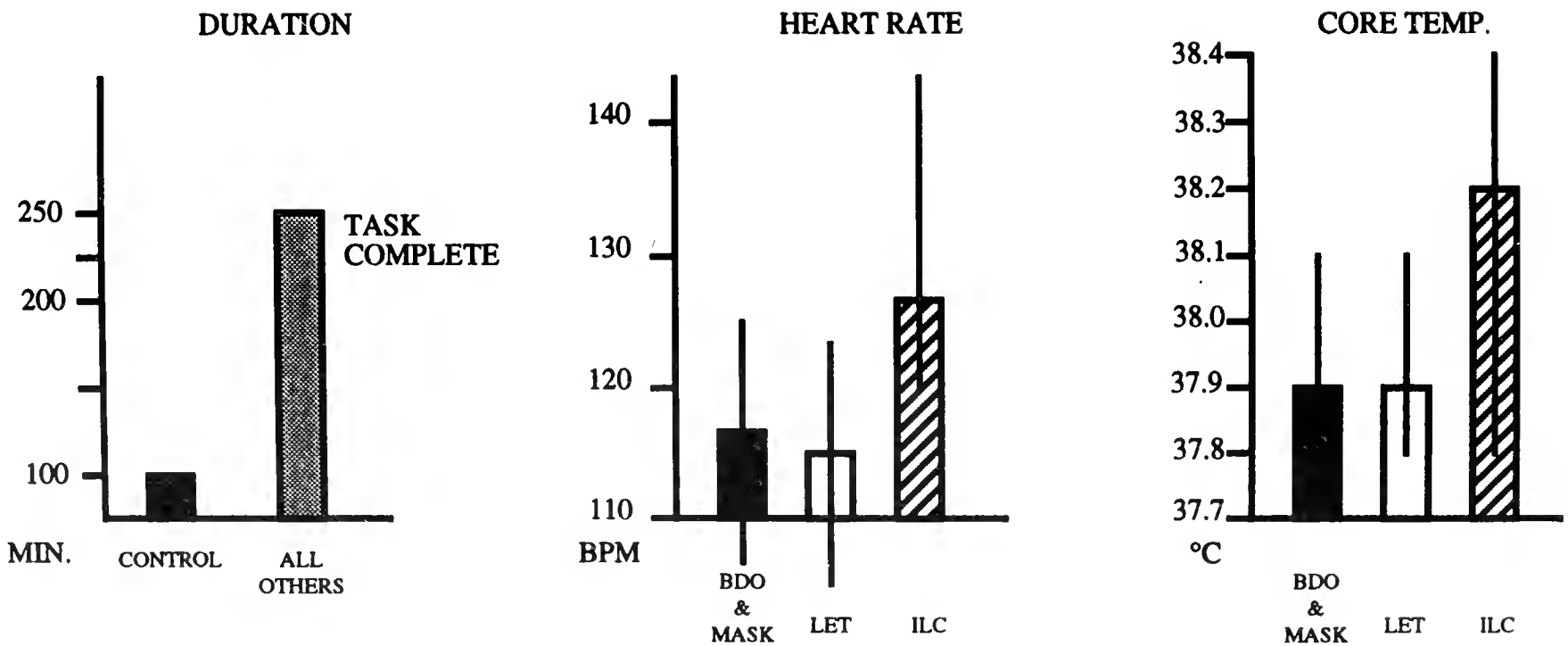


Significant Reduction Of All Heat Stress Factors

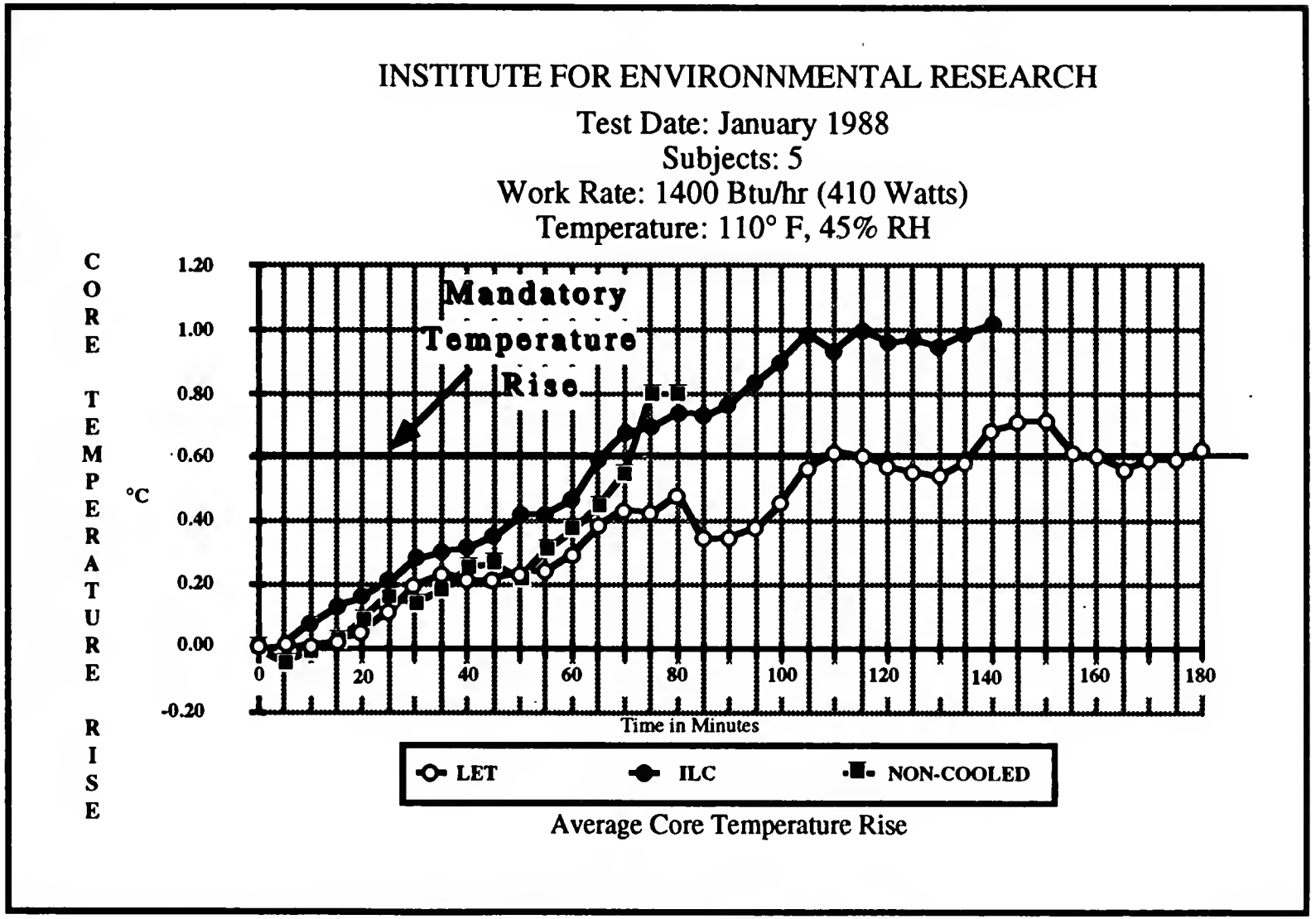
- Sweat Rate — Total > 70%; Facial > 90%
- Heart Rate Rise — 80%
- Core Temperature Rise — 82%
- Discomfort — 80%

D-46

AIR FORCE
RAPID RUNWAY REPAIR
WEARING MOPP-4 ENSEMBLES
TESTS CONDUCTED IN 1982
TEMP. 86°-95° F



- Only Marginal Performance Obtained By ILC
- Resupply Time: 30 Seconds For LET, 9 Minutes For ILC


INSTITUTE FOR ENVIRONNMENTAL RESEARCH
Test Date: January 1988
Subjects: 5
Work Rate: 1400 Btu/hr (410 Watts)
Temperature: 110° F, 45% RH
CORE TEMPERATURE RISE
°C
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
Mandatory
Temperature
Rise
0
20
40
60
80
100
120
140
160
180
Time in Minutes
LET
ILC
NON-COOLED
Average Core Temperature Rise

D-211A

Health and Medicine

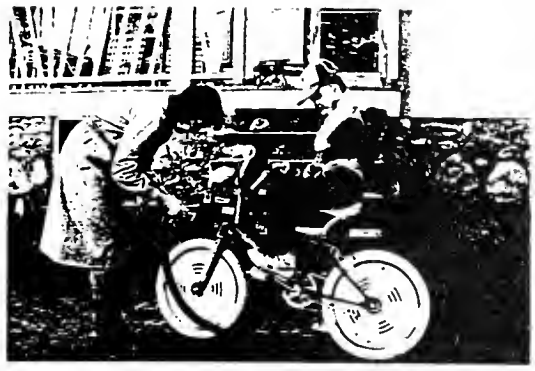
Cool Suit

The system can eliminate 40-60 percent of stored body heat

Young Stevie Roper could only watch from the sidelines while other children played schoolyard games. Victim to a rare skin disease called hypohydrotic ectodermal dysplasia (HED), Stevie was born without the sweat glands needed to eliminate excess body heat. As a result, any physical exertion or exposure to warm temperatures could induce heat stroke.

Years ago, during a visit to his aunt, Sara Moody, Stevie became overheated while riding in a non-air-conditioned car. He was saved by a quick-thinking cousin who spotted a lawn hose, stopped the car, and doused him with cold water.

The incident prompted Ms. Moody to seek the help of NASA's Langley Research Center, which put her in touch with Life Support Systems Inc. (LSSI) of Mountain View, California. A manufacturer of personal cooling gear, LSSI fabricated a child-size version of its Mark VII Microclimate Cooling Suit. The outfit consists of a helmet liner and vest that fit comfortably beneath the boy's clothes. An antifreeze solution cooled by a portable, battery-powered refrigeration unit is pumped through tubes to the garments. The system can eliminate 40-60 percent of Stevie's stored body heat while lowering his heart rate by 50-80 beats per minute.



Born without sweat glands, Stevie Roper lives a closer-to-normal life by wearing a space-derived cool suit. Coolant circulates through tubes in the vest and headpiece to prevent overheating.

The Mark VII suit originated in a 1960s NASA program that produced a channeled cooling suit for astronauts. While now used mainly in industrial settings that require heavy protective clothing, such as nuclear power plants and steel mills, the suit also has found numerous military applications. Other uses include relieving cockpit heat stress for race car drivers and cooling firefighters. In 1988, LSSI released the ThermoAire Splint™, based on the same technology, to replace ice packs and elastic bandages for sports injuries.

The lack of sweat glands in Krystal Sharrett's feet had caused serious sores and threatened amputation. Presented a cool suit in April 1989, Toby improved dramatically and by June the sores had completely healed.

Gary Radne of Life Support Systems, Inc. displays a HED cool suit—headcap and torso vest—that is a child-size version of the company's MicroClimate line of protective garments for workers whose jobs subject them to heat stress.

Following media coverage of Stevie's story, LSSI began receiving requests from around the world for suits to help people with HED and other diseases and conditions—including multiple sclerosis, cystic fibrosis, severe burns, and some forms of cancer—that can make a person prone to overheating. The suits can be custom-made for particular body parts or problems, and have enabled many people to participate in sports and other strenuous activities from which they were previously barred.

Cropduster pilot Gary Owens solved the problem of high cockpit temperatures with his LSSI cool suit.

Title	:	HELP FOR MS PATIENTS
Chapter	:	HEALTH AND MEDICINE
Publication	:	SPINOFF 1993
Page No.	:	52
Center	:	AMES RESEARCH CENTER
Contact	:	MR. CLYDE KANEGAWA
Manufacturer	:	LIFE SUPPORT SYSTEMS, INC.
	:	1400 N. SHORELINE BLVD., SUITE 4-A
	:	MOUNTAIN VIEW, CA 94043
Phone Number	:	(415) 962-9800
Transfer Mechanism	:	NASA ASSISTANCE
License/Patent	:	
Origin	:	MERCURY, GEMINI, APOLLO
Photographs	:	YES
Lead	:	CLIPPING, PREVIOUS SO 86-P. 50, SO 89-P. 56
Technical Terms	:	CHRONIC CONDITIONS, DISEASES, COOLING SYSTEMS, COOL SUIT, LIQUID COOLING

The Mark VII MicroClimate Medical Personal Cooling system enables multiple sclerosis victims, as well as cerebral palsy, spina bifida patients and others to lower their body temperatures. Although this is not a cure, cooling can produce a dramatic improvement in symptoms. The Multiple Sclerosis Association of America has placed cool suits in MS research care centers. This technology originated in the need for cooling systems in space suits. "Cool Suits" are now used by hazardous materials workers, armored vehicle crews, firefighters and crop dusters. A surgical personal cooling system has also been developed for medical personnel working in hot operating room environments.

Testimony of Michael G. Ury,
Vice President, Fusion Lighting Inc.
Before the
US House of Representative
Committee on Science,
Subcommittees on Technology and Basic Research
June 27, 1995

Chairpersons Morella and Schiff, Members of the Subcommittees, my name is Michael Ury and I am the Vice President of Fusion Lighting, Inc., a 30 person start-up company based in Rockville, Maryland which is developing a unique class of high efficiency light sources based on the use of sulfur and sulfur-related materials. I have worked for 25 years in the field of high intensity microwave-powered lamps, first for a company named Fusion Systems Corporation and, for the last three years, for Fusion Lighting. Although they are close to the Beltway, neither company is in the business of being government contractors. Fusion Systems is today a very successful, $100 million capital equipment supplier to the semiconductor and other industries. Fusion Lighting was created as a spin-off of Fusion Systems at the end of 1992 when we realized that the discoveries that we had made could lead to whole new families of general lighting products. We appreciated that the commercialization of such products could take years and a great deal of capital, and that the general lighting business would be very different than the business of Fusion Systems.

I am here to comment about our experience at Fusion Lighting over the past three years, in working with the Department of Energy (DoE) and with the Lawrence Berkeley Laboratory (LBL), one of its contractor-operated labs. Because we had already made the fundamental inventions critical to the sulfur lamp before we had any contact with DoE or LBL, this is not a story of technology transfer in the traditional sense of the word. However, in my opinion, it is a story of constructive collaboration between a small venture capital-backed company and the Federal Government.

In 1990, while still at Fusion Systems, we discovered that sulfur gas, when excited by microwave energy under the proper conditions, produces a very pleasing visible light source, much like sunlight. The sulfur bulbs have some other very important characteristics - they seem to last for a very long time, they do not have any dangerous mercury in them (unlike all other high performance lights) and, most interestingly to the DoE, they hold the promise of being more efficient than any existing light sources.

Since lighting consumes 25% of the electricity in the US, better light bulbs can make an enormous difference in reducing the need for new electrical power generation.

In 1992 I met Dr. Lee Anderson, the Program Director for DoE's Lighting Research. Dr. Anderson immediately grasped the potential benefit of this infant technology and asked us to collaborate with LBL, which is the DoE's center for advanced lighting Research and Development. We signed a cooperative research agreement with LBL and provided their scientists with information regarding our technology. They rapidly made some important progress in extending our work to different performance ranges, and used their expertise in lighting fixtures to start thinking about how to best use the high power sulfur lamp. However, when key researchers at LBL retried, DoE decided to transfer some of the research to Fusion Lighting and we have just completed the first year of R&D with DoE support. We have received modest amounts of government support over the last several years from the EPA, NASA, and the NSF as well. In addition, DoE supported two demonstrations of the sulfur lamp technology last year; we relit the East bay of the National Air and Space Museum and used a unique "light pipe" to illuminate the area outside the entrance to the DoE Headquarters on the Mall. I should also point out that the large preponderance of the funding that has gone into Fusion Lighting has been private funding - in the form of contracts from potential customers and in the form of venture capital.

Looking back over our experience of the last several years, I would make a few comments on the subjects of interest to your Subcommittees:

- To the extent that the US government has a role in encouraging energy efficiency for the national good, and I personally believe that it does, it should be looking at energy-efficient lighting because of the enormous energy demand created by lighting.

- There is only one major lamp company left that is US-owned, and only three major lamp companies, in total, servicing most of the world. These companies have large investments in existing technology and have not been very aggressive in exploring advanced new technology. Indeed, one of the side-benefits to the nation from the DoE support of our sulfur work has been to stimulate a higher level of investment by the major lighting companies in new technology.

- The DoE laboratory system is an important national resource. LBL has important skills in light system design and light measurement that are broadly valuable to industry and to the public at large. This expertise would be difficult and expensive to replace.

- The knowledge and commitment of people in the Energy Efficiency program at DoE is also an important national resource. Many of the people we have dealt with have been devoted to their programs and to the goals of energy conservation.

Let me make one point quite clear. Fusion Lighting is an entrepreneurial company. We want to grow and be successful and reward our investors. We would have done most of the things we have done without any support from DoE or from LBL. However, it would have taken longer and been riskier, and perhaps we would have failed. The support of DoE and LBL has been important in the critical early years of our company. It seems to me that, given the major potential benefit to the nation in reducing the energy demand from lighting, and given the fact that we are a very small company with a brand new technology in an industry dominated by giants, it was and is entirely appropriate to use some resources of the Federal Government to help launch this effort.

I would like to invite each of you to stop and see our demonstrations on the Mall and to visit us in Rockville. I will be glad to answer any questions you have.

DOE NEWS

NEWS MEDIA CONTACTS:
Chris Kielich, Keith Holloway,
Hope Williams, 202/586-5806

FOR IMMEDIATE RELEASE
May 1, 1995

SULFUR LIGHT WINS!
ENERGY DEPARTMENT and FUSIONLIGHTING, INC. HONORED

The Sulfur Light -- a scientific and technological breakthrough in lighting developed by FusionLighting, Inc. of Rockville, MD and the U.S. Department of Energy (DOE) -- has won the 1995 DISCOVER Award for Environmental Technological Innovation. The award honors the best American technology to be developed in each of seven categories during the past year.

The sulfur light was invented by FusionLighting, Inc. and developed with scientists at DOE's Lawrence Berkeley Laboratory. Powered by microwave energy, the mercury-free sulfur light has no wires, filaments or metal parts to burn out. The light released by the lollipop-shaped bulb is brighter and more energy efficient than lights available today.

During the awards ceremony, held at Epcot '95 in Walt Disney World on Saturday, Secretary Hazel R. O'Leary and Michael Ury of FusionLighting unveiled "Solar 1000," the next generation of sulfur light that delivers the equivalent of eighty 100-watt conventional household light bulbs from a device the size of a shoebox.

- MORE -

R-95-059

Printed with soy ink on recycled paper

■ U.S. Department of Energy • • Washington, DC 20585 ■

SUBCOMMITTEE ON TECHNOLOGY AND
SUBCOMMITTEE ON BASIC RESEARCH
HOUSE SCIENCE COMMITTEE

JOINT HEARING REGARDING
FEDERAL TECHNOLOGY TRANSFER POLICIES AND OUR FEDERAL LABORATORIES

JUNE 27, 1995

PANEL THREE SYNOPSIS

Panel Three witnesses are representatives of companies which have developed new products and applications with Federal laboratories. The witnesses can testify, from an industry perspective, to the process of first-hand interaction with our Federal laboratories. They can also discuss their personal successes and failures of our Federal technology transfer policies.

Mr. Thomas Fortin represents Rio Grande Medical Technologies in Albuquerque, NM. Working with Sandia National Lab, they have developed infrared sensors which measure blood-glucose levels in humans. Painless, fast, and much more informative than the standard blood test, the glucose monitor will make life a little easier -- and much safer -- for the frequent bloodsugar tests for diabetics.

Mr. Michael Ury represents Fusion Lighting in Rockville, MD. Working with the DOE's Lawrence Berkeley Laboratory, they have developed The Sulfur Light -- a scientific and technological breakthrough in lighting. Powered by microwave energy, the mercury-free sulfur light has no wires, filaments, or metal parts to burn out. The bulb is brighter and more energy efficient than conventional lights.

Mr. William Elkins represents Life Enhancement Technologies in Mountain View, CA. Working with NASA's Langley Research Center, they have developed a "cool suit." This product has enabled Multiple Sclerosis (MS) victims, as well as cerebral palsy, spina bifida patients and others to lower their body temperatures. Although not a cure, cooling can produce a dramatic improvement in symptoms. Cool Suits are now used by hazardous materials workers, armored vehicle crews, firefighters, and crop dusters, among others.

Mrs. MORELLA. I just want you to know that it's so good to end this very long hearing hearing some success stories of working with the federal government.

Mr. Fortin, the infrared sensors, and Mr. Elkins, that cool suit, and Mr. Ury, the sulphur light, are all excellent examples of what can be done. And I hope that we can do something federally to hasten the process of the kinds of partnerships that have resulted in your successful products. Thank you very, very much.

And may I just remind everybody that Mr. Schiff is hosting the reception right next door in our space room 2325—speaking of NASA.

The meeting is adjourned.

[Whereupon, at 5:30 p.m., the meeting was adjourned, subject to the call of the Chair.]

APPENDIX

NATIONAL ASSOCIATION OF STATE DEPARTMENTS OF AGRICULTURE

June 27, 1995

The Honorable Constance Morella Chairwoman,
House Science Subcommittee on Technology
The Honorable Steven Schiff, Chairman
House Science Subcommittee on Basic Research
2319 Rayburn House Office Building
Washington, DC 20515

Dear Representatives Morella and Schiff:

The National Association of State Departments of Agriculture (NASDA) is a nonprofit, nonpartisan association of public officials comprised of the executive heads of the fifty state Departments of Agriculture and those from the territories of Puerto Rico, Guam, American Samoa and the Virgin Islands. NASDA's purpose is to better American agriculture through the development and promotion of sound public policy and communicating that policy and the vital importance of agriculture at the federal, state and territorial levels.

NASDA believes that promoting partnerships between the federal government labs and the private sector is both beneficial and necessary if the U.S. is ever to regain its place as a world leader in the science and technology fields. We would probably all be surprised at the amount of research dollars spent over the years resulting in products and product concepts sitting on a shelf somewhere because either funding was cut off too early or private companies were not given the opportunity to work closely with government labs in order to perfect and then bring them to commercialization.

We must also ask how much government research has been conducted over the years on projects that, when completed were not wanted or needed by the private sector. The lack of communication between private business and government laboratories creates problems for both entities. Government researchers do work they think industry wants or needs only to find that it does not fit the needs of the private companies. The only way for government labs to know what is needed by private industry is to work closely with them sharing ideas and technology. This increases the value of government dollars spent by actually producing a product or process that benefits both participants. The government researcher learns more about what is needed by the private business and the private company will come away with a product or process that will expand or add value to his product line or business.

On the other hand many small-to medium-sized private companies often lack the scientific expertise and/or funding to carry out highly speculative research that could not only help the bottom line of the company but also the economic well being of an entire community. With the budget constraints both the public and private

Richard W. Kirchhoff, *Executive Vice President & Chief Executive Officer*

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sectors are under today, the mounting trade deficit we face, and the need to create jobs for American citizens, it only makes sense to allow government and the private sector to join forces for the common good of everyone.

Today the USDA has a program that exemplifies this spirit of cooperation between the public and private sector The program is the Alternative Agricultural Research and Commercialization (AARC) Center.

The AARC Center is an independent agency within the U.S. Department of Agriculture (USDA), created by Congress to expedite development and market penetration of industrial (nonfood, nonfeed) products from agriculture and forestry materials and animal by-products. It assists the private sector in bridging the gap between research results and commercialization of that research, thereby complementing USDA's research agencies. As a public entity, the AARC Center forms partnerships with private firms to commercialize research that may have been developed with public or private funds

The AARC Center receives an annual appropriation from Congress and also operates a revolving fund. When AARC invests in a project it negotiates a payback arrangement such as a stock option or royalty agreement. When repayments are received they are placed in the revolving fund, where they will be reinvested in future projects.

For fiscal years 1993 and 1994, the first two years of full operation, AARC invested $15.3 million, matched by $43 million from the private partners in 37 projects. The statute which authorizes AARC requires at least a 50 percent match for these activities, however, the private-public ratio is approaching 3:1 In addition, it has been estimated that for each $3 million invested by AARC, 1,000 jobs have been created

NASDA believes that allowing the federal government to partner with the private sector will have a very favorable effect on both the public and private sector, creating new products and technologies which will then result in new business opportunities and jobs.

We respectfully request that this letter be included in the hearing record, June 27, 1995 on ways to create more partnerships between the federal government's technology labs and the private sector.

Sincerely,

Mark C. Nestlen
Director, Legislative & Regulatory Affairs

Los Alamos
NATIONAL LABORATORY

Industrial Partnership Office
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(505) 665-9090/ FAX (505) 667-4098
Date: July 7, 1995
Symbol: IPO:95-452

The Honorable Bill Baker
1724 Longworth House Office Building
Washington, DC 20515-0510

Dear Representative Baker:

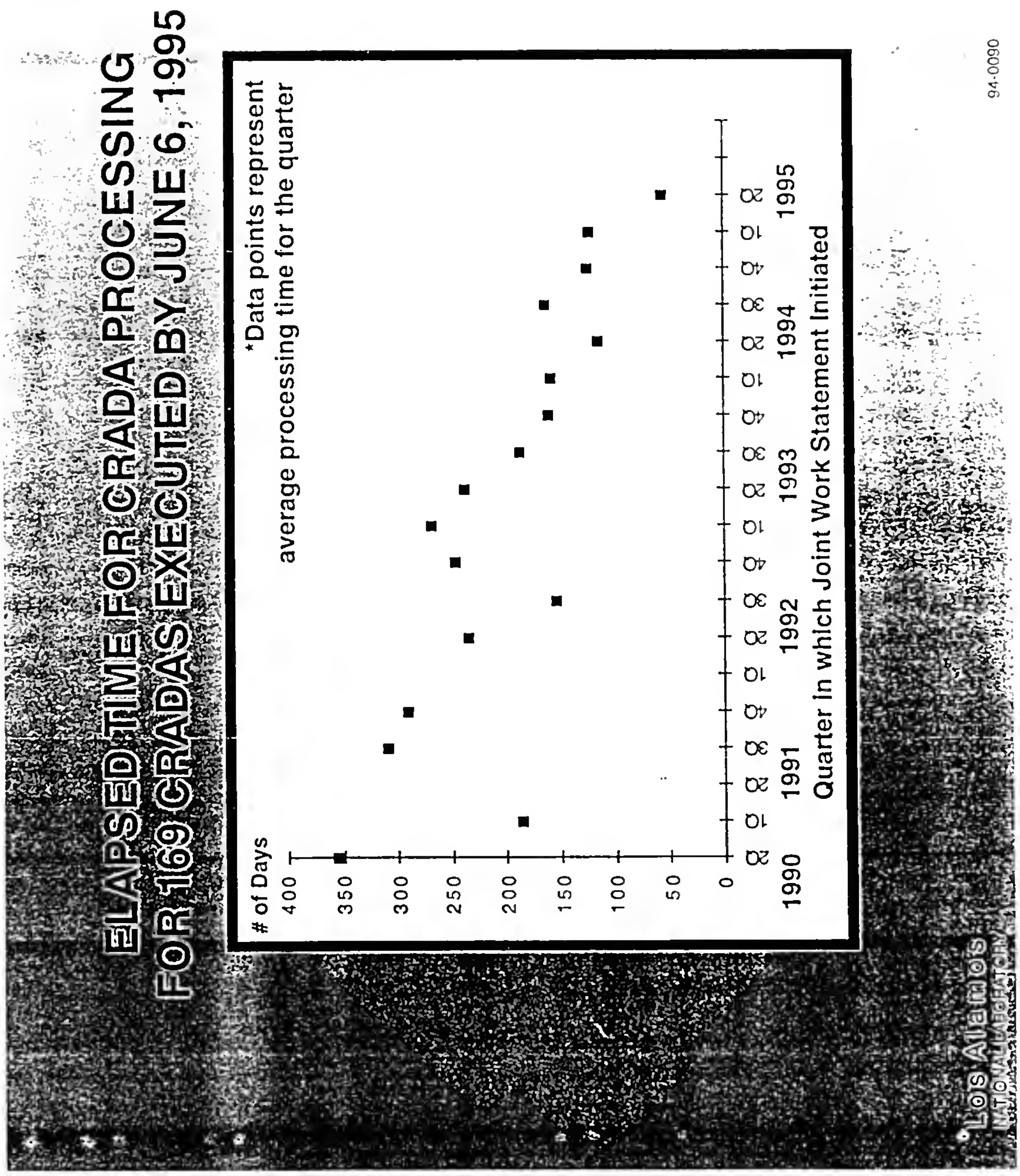
I appreciated the opportunity to testify before the Joint Hearing of the House Science Committee on Technology Transfer on June 27. In response to one of your questions, I offered to provide you with information on processing times for Cooperative Research and Development Agreements at Los Alamos National Laboratory. That graph is attached. Please note that our response time has continued to improve. These improvements have been enabled by significant process improvements involving the Department's Headquarters and Albuquerque Field Office staff and Los Alamos efforts. Similar improvements would be equally apparent from other national laboratory's data as well.

You may recall that I sought at several points to emphasize the contributions of industrial interactions directly to Laboratory missions. I am extremely concerned that some of the current suggestions of "corporate welfare" surrounding industrial interactions of the defense laboratories simply do not recognize that our ability to accomplish our defense mission is at risk without these interactions. Of course, we carefully select cooperative areas that are of interest to industry in order to gain their enthusiastic participation, but at the same time we are directly supporting the Laboratory's missions. Any cuts in budgets for industrial interactions will hurt our defense missions. I hope I was able to communicate this key point effectively in the Hearing.

If I can provide additional information, please let me know. Your interest in this critical area of Laboratory programs is greatly appreciated.

Sincerely,

Peter B. Lyons, Director
Industrial Partnership Office



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